DOCUMENT RESUME

ED 185 255 CE 024 322

AUTHOR	Havemen, Jacqueline E.; O'Connell, Kathryn
TITLE	Environmental Quality and Energy Conservation Curriculum Model. Final Report.
INSTITUTION	Far West Lab. for Educational Research and Development, San Francisco, Calif.
SPONS AGENCY	Bureau of Occupational and Adult Education (DHEW/OE), Washington, D.C.
BUREAU NO	498AH70085
PUB DATE	Apr 79
GRANT	G007701943
NOTE	102p.
EDRS PRICE	MF01/PC05 Plus Postage.
DESCRIPTORS	Conservation Education; Curriculum; *Curriculum Design; Curriculum Development; Curriculum Research; Energy; *Energy Conservation; *Environmental Education; Environmental Standards; Interdisciplinary Approach; Material Development; *Models; Natural Resources; Need Gratification; Postsecondary Education; Power Technology; Quality of Life; Science Education; Teacher Developed Materials; *Vocational Education
IDENTIFIERS	Energy Education

ABSTRACT

To provide postsecondary vocational educators with a comprehensive understanding of environmental quality and energy conservation and their relevance to all occupational fields, a project designed a generic curriculum model for postsecondary adult and vocational education and developed documents describing the model. In developing the model, a conceptual framework was used that focused not only on energy resources and technologies, but also on understanding relationships between energy conservation and environmental quality and human need satisfaction. Seventeen content areas were specified and organized into four documents--orientation guide, curriculum content model, resource book, and application guide. (They are also available separately as ED 178 323.) Other activities included development of a knowledge base regarding specific programs into which the model could be integrated, and information dissemination. Evaluation involved an advisory panel review of the appropriateness of the project's approach, educators' review of the documents, and workshop review by classrooom instructors. It was concluded that the model provided an effective starting point for staff development activities (inservice or preservice training) and for educator development or use of energy conservation-related materials. (Appendixes, amounting to approximately one-half of the report, include a Teacher's Energy Guide developed by a community college instructor.) (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED185255

ERIC

Final Report

Project No. 498AH70085

Grant No. G007701943

Jacqueline E. Havemen
Kathryn O'Connell
Far West Laboratory for Educational
Research and Development
1855 Folsom Street
San Francisco, California 94103

ENVIRONMENTAL QUALITY AND ENERGY CONSERVATION CURRICULUM MODEL

April 1979

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

Bureau of Occupational and Adult Education

CE 021 322

ABSTRACT

Since the early 1970's, increasing attention has been given to the development of student programs and materials related to the subject areas of environmental quality and energy conservation. A similar emphasis has not been placed on helping educators to understand these topics. The purpose of the design project described in this report was to respond to this need through the design of a generic curriculum model providing post-secondary vocational educators with a comprehensive understanding of environmental quality and energy conservation and the relevance of these two topics to all occupational fields. In developing the model, a conceptual framework was used that focused on energy conservation embedded within the context of environmental quality and the satisfaction of human needs. Draft versions of the model components were reviewed by a group of local educators and revised according to their suggestions. The project's final products, a series of four documents, were submitted in a separate volume entitled the Energy Conservation Curriculum Model, which accompanies this report. The Model provides a generic conceptual base for the development of instructional programs or materials for educators in a variety of vocational areas. The next logical step would be the development of materials based on the Model for a specific occupational setting.

ACKNOWLEDGEMENTS

The project staff would like to thank the following people and institutions for their contributions to the project:

The Project Advisory Panel

Ron Nelson, Associate Dean, Foothill College
Beverly Parks, Associate Project Director, American Institutes of Research
Nancy Swadesh, Administrative Director for Instructional Services, Community College Centers of the San Francisco Community College District
Harry Wolf, Professor, Golden Gate University

The Curriculum Model Review Panel

Ralph Bohn, Dean of Continuing Education, San Jose State University
Rudolf Graeter, Instructor, San Francisco Community College Center
Donald Leach, Instructor, De Anza Community College
C. C. Norment, Dean of Technical Studies, San Jose City College
Les Schwoob, Instructor, Foothill Community College
George Woodward, Instructor, San Francisco Community College Center

Community College Centers of the San Francisco Community College District

A special word of thanks should also be given to the administration of the Community College Centers for providing release time for a member of the Centers' instructional staff, George Woodward. Mr. Woodward participated in the project in order to help develop the energy and environmental education components of the Community College Centers' programs. Mr. Woodward's enthusiasm and perspectives were important contributions to the project.

Far West Laboratory

Bela Banathy, Executive Research Director, for review of the project documents
Vicki Tiernan and Mary Bradish, for editorial assistance
Carol Burkhart, Rick Grasso, E. Marcilan, and Marilyn White for secretarial support

FINAL REPORT

Project No. 498AH70085

Grant No. G007701943

ENVIRONMENTAL QUALITY AND ENERGY CONSERVATION CURRICULUM MODEL

Jacqueline E. Haveman
Kathryn O'Connell

Far West Laboratory for Educational
Research and Development
1855 Folsom Street
San Francisco, California 94103

April 1979

The activity which is the subject of this report was supported, in whole or in part, by the United States Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the United States Office of Education, the Department of Health, Education, and Welfare, or the Far West Laboratory for Educational Research and Development, and no official endorsement by these agencies should be inferred.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education

Bureau of Occupational and Adult Education

TABLE OF CONTENTS

ABSTRACT i

TABLE OF CONTENTS v

LISTS OF TABLES AND FIGURES vi

CHAPTER ONE: Introduction 1

CHAPTER TWO: Model Design Methodology and Procedures. 7

CHAPTER THREE: Remaining Project Objectives: Procedures and Results . . 25

CHAPTER FOUR: Conclusions and Recommendations 33

FOOTNOTES 35

BIBLIOGRAPHY 37

APPENDICES 39

Appendix A: Request Letter A-1

Appendix B: Working Paper for Advisory Panel B-1

Appendix C: Community College Developed Materials C-1

Appendix D: Project Information Letter D-1

Appendix E: Project Workshop Materials E-1

Appendix F: Model Information Report F-1

LIST OF TABLES

TABLE		PAGE
1:	Workshop Evaluation Results	30

LIST OF FIGURES

FIGURE		PAGE
1:	Human/Natural Systems Interaction Model	9
2:	Conceptual Framework for Curriculum	9
3:	Energy Conservation Model Content Areas	18
4:	Themes of Curriculum Content Model	21
5.	Content Areas Included in Each Model Document	22

CHAPTER ONE

INTRODUCTION

The Energy/Environmental Crisis

There is little doubt, today, that the United States faces a crisis in maintaining the quality of its environment and in conserving its sources of energy. In 1977 when the proposal for this project was written, much of the Midwest and East were in the midst of winter that had brought severe cold weather, blizzards, and fuel shortages. In the Northwest, there was a drought that promised to affect both the availability of hydroelectric power and the environment. And, at almost the same time the National Wildlife Foundation announced that the overall quality of the environment in the United States had declined for the seventh straight year.

In 1979, as this report is being written we are once again in the midst of an energy crisis and face a summer of possible gasoline shortages. In addition, the Three Mile Island nuclear accident has added new dimensions to our energy/environmental problems. There are already questions about how electricity needs of those depending on the nuclear plant power will be met in the high-use summer months. Perhaps more importantly, there is concern about the possible effects of radiation on not only human health, but also the "fitness" of the surrounding agricultural land. Whether or not the accident could ever happen again is really not the issue. This accident, unlike our other crises, has demonstrated vividly that the issues of energy and environment are closely related.

Education's Response to the Energy/Environmental Crisis

There has been a wide range of suggestions as to how we can deal effectively with our energy/environmental problems. Most of these involve the

implementation of state or federal legislation and policies. Because these policies will affect the public and will be successful only if publicly supported, it is felt that education will be the key to their success. And educators have accepted this responsibility calling at first in the early 70's for the development of environmental education programs and more recently for energy education programs. Indeed as John M. Fowler and King Kryger, early leaders in the energy education field, pointed out in a tongue-in-cheek fashion, "the many facets of the energy crisis lend themselves so well to education that if it had not occurred educators might have invented it."[1]

In 1977, when this project originated, there were several characteristics to this educational response. First of all, it was basically confined to programs for students in grades K-12. Moreover, few systematic attempts were being made to develop programs that could be used with adaptation in a variety of settings. It seemed that each individual school district desiring to implement educational programs on these topics had to start from scratch and "reinvent the wheel."

Secondly, there were varying levels of meaning attributed to the terms energy education, environmental education, and energy conservation education. To many, environmental education meant learning about preservation of natural resources existing basically in rural uninhabited areas and energy education entailed learning about energy resources and the advantages and disadvantages of various energy technologies. Energy conservation education, on the other hand, was a subset of energy education in which the emphasis was on ways to reduce consumption of energy.

These rather narrow definitions of the domains of environmental, energy, and energy conservation education were challenged by those who felt that these topics involved much broader and more encompassing issues. Indeed the

Environmental Education Act as amended specified that environmental education included the following list of topics: population dynamics, pollution, resource allocation and depletion, conservation, transportation, technology, urban and rural planning, environmental quality, ecological balance, natural resource related careers, economic and technological development, environmental ethics and energy.[2] And others said that education in these areas must be "holistic" in nature reflecting an interdisciplinary approach and leading to an environmental or energy ethic or literacy.[3] Although these suggestions seemed reasonable, few concrete suggestions were offered to educators as to how this could be done.

Thirdly, many educators were expressing the need for instructional materials to be used in the classroom.[4] At the time, except for texts in ecology and in the technical aspects of energy, educational publishers, themselves, had few offerings for classroom instructors. Materials developed by local education agencies were often unavailable as dissemination is not a typical, and is perhaps an inappropriate, role for these agencies. On the other hand, at the same time there was a proliferation of materials being produced by public interest groups, utilities, government agencies, and professional or trade associations. Although it is true that these materials were often narrowly focused or, quite understandably, reflected the particular viewpoint of the producing agency, these materials were potentially useful in the classroom if the instructor had a comprehensive understanding of energy conservation or environmental quality.

In fact, it appeared not suprisingly that most educators did not have this understanding of energy or environmental topics. At the time, little attention was being paid to educator training. A few in-service programs and summer institutes were being held, but, in the main, education was being

challenged to help solve our energy problems with little thought as to what teachers would need to know in order to do so. As a result, educators were saying that greater emphasis should be placed on pre- or in-service training.[5]

The Response of Adult and Vocational Education to the Energy/Environmental Crises

Although the generalizations cited in the previous section applied mainly to education outside of the vocational and adult education area, discussions on energy and environmental topics were also going on in these fields. In the vocational area, the discussion, however, seemed to focus on the fact that workers were going to be needed in energy or environmentally related jobs and occupational programs would have to be developed to train these workers. In the adult area, the emphasis was on techniques for reducing end-use consumption of energy through home insulation and other techniques or to create an awareness of local environmental problems. Indeed, an ERIC search done in preparing the project proposal revealed very few entries in which vocational education or adult educators addressed the broader issues of energy and the environment and the role these forms of education could play in dealing with our nation's energy and environmental problems.

Yet, it seemed logical that vocational and adult education could contribute much toward increasing the energy and environmental literacy of our adult and working population. If we are to effectively cope with these problems, all workers will have to be environmentally aware and energy conscious Each one will need to understand techniques for conserving energy and preserving environmental quality through modifications in the work environment and to be able to make job adjustments based on energy or environmental priorities. These energy and environmentally literate workers will be as needed and as important to solving our energy problems as workers skilled in energy or

environmental technologies or energy conservation specialists. Nonetheless, very little activity was being carried out in the field with this perspective in mind.

The Purpose of this Reported Project

The primary purpose, then, of the project described in this report was to respond to this need by designing a generic* environmental quality and energy conservation curriculum model** for post-secondary adult and vocational education. As it turned out, the project activities focused on energy conservation. As will be described in the next chapters, this was done because energy is, at this time and in the foreseeable future, a primary national concern and because the content of the Model includes environmental quality as an integral component which must be considered in meeting energy needs.

A series of four documents describe the Energy Conservation Curriculum Model. They are being submitted as a separate set of materials along with this report. The Model consists of the following component documents:

1. An Orientation Guide presents the rationale for the Model and provides an overview of the remaining documents.
2. A Curriculum Content Model provides a conceptual framework organizing and describing the generic content of energy conservation.
3. A Resource Book elaborates on the knowledge components of the Curriculum Content Model and contains bibliographies of useful reference materials and information resources.

---

*Meaning that the model is written in general terms providing a basis for the development of instructional programs in specialized occupational fields.

**A curriculum model is an organized description of the various content domains in which teachers need to obtain competence.

4. An Application Guide contains guidelines and suggestions as to how energy conservation could be implemented in adult and vocational education instructional settings and provides four examples of how this might be done.

The next two chapters describe specific project objectives and the procedures used by the project to meet these objectives. The first of these chapters deals solely with the approach and methodology associated with model design and development activities. The chapter following describes the remaining project objectives and procedures used to meet these objectives.

CHAPTER TWO

MODEL DESIGN METHODOLOGY AND PROCEDURES

The major objective of this project was the design of a curriculum model and the development of a series of documents describing this model. In this chapter, the methodology and procedures used in designing the model and the model-related documents will be described. The project's final products, the model components, are included in a separate document submitted with this report. The next chapter will describe the remaining technical objectives of the project which in addition to model design were:

- to develop a knowledge base that would allow integration of the model into specific programs;
- to evaluate the model; and
- to disseminate information about the model.

The Project is Approach to Model Design and Development

The approach to the design and development tasks of the project was based on two important organizing perspectives concerning specifically, the nature of energy/environmental education and the general process of curriculum development. These two perspectives influenced the procedures used in designing and developing the products of the project.

First of all, model design activities were based on a systemic approach to curriculum design and development. Essentially, this approach as described by Bela Banathy requires the curriculum developer to systemically address a series of questions and then to develop components of the model based on the specifications resulting from the answers to the questions.[6] These questions include the following:

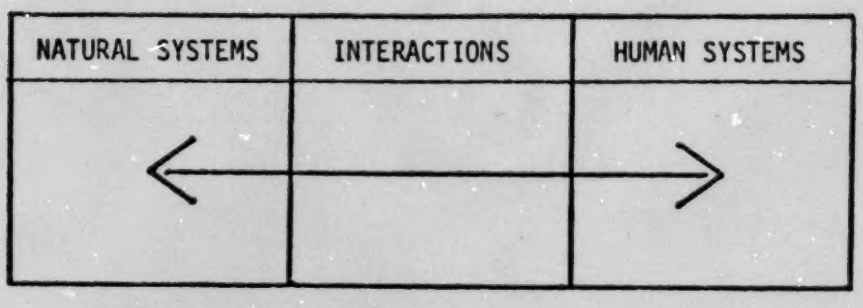
- Why does the educator need to know about energy conservation?
- What does the educator need to know to develop a comprehensive understanding of energy conservation?
- What learning materials and resources are useful in acquiring this understanding?
- What types of instructional and learning arrangements are needed to transmit this understanding to the educator's students?

Secondly, because project staff had previous experience in working in energy and education areas, they were in essential agreement with those who called for a "holistic" approach to energy and environmental understanding. The term holistic refers to the merging of knowledge in several areas and viewing them comprehensively as a "whole" rather than utilizing a segmental approach to problems and issues.

Furthermore, prior to beginning work on this project, staff members had become familiar and were in agreement with a particular approach that had been developed by Far West Laboratory with regard to the specification of content on environmentally related topics.[7] This approach had been designed to ensure identification of all key concepts and relationships important to gaining a comprehensive understanding of an environmentally related topic. The rationale for this approach revolves around the fact that our human system and all of its activities are contained or "nested" within the natural system. Conflicts and problems occur when either system upsets the balance or health of the other. Most frequently, environmental problems occur when human system activities, for example, oil spills or land abuse, upset the balance of the natural system. Hence, to understand and to prevent these conflicts, we must understand not only the activities of the human system and the natural system, but also must examine the interactions between the two. Such an approach may be graphically portrayed as displayed in Figure 1 with the human and natural system influencing each other.

Figure 1

HUMAN/NATURAL SYSTEMS INTERACTION MODEL



A further distinction is made within this framework relative to the conceptual and operational aspects of human/natural system interactions. This distinction was made in order to explore not only observable or "real world" phenomena (the operational level), but also the way we think about or analyze these events (the conceptual level). As we know, our problems often stem from the way we think about these phenomena, so it is critical that we are aware of and examine these aspects. Thus the framework now takes on the following form, which became the basis later in the project for the development of the Curriculum Content Model.

Figure 2

CONCEPTUAL FRAMEWORK FOR CURRICULUM CONTENT MODEL DEVELOPMENT

	NATURAL SYSTEMS	INTERACTIONS	HUMAN SYSTEMS	
OPERATIONAL				OPERATIONAL
CONCEPTUAL				CONCEPTUAL

These two perspectives, then, guided the project as the staff focused on specific design and development tasks. These included the following:

- Reviewing relevant literature to establish a knowledge base.
- Based on the results of the literature review, the purpose of the project, and initial organizing perspectives, specifying the content areas to be included.
- Based on these areas, organizing the content thus providing specifications for project products, and then developing the curriculum model documents themselves.

It should be pointed out that as project staff worked through the design and development process, they were joined by a member of the instructional staff from the adult education program at the San Francisco Community College Centers. The purpose for the instructors' work with the staff was not to actually assume responsibility for the project work, but to adapt from project activities those things which could be used to set up energy and environmental programs in the Community College Centers. The instructor served then as a "sounding board" for the project. Release time was provided by Community College Centers at no cost to the project. The Project Advisory Panel also provided input during the early stages of model development.

The next sections will describe the model design and development tasks in more detail. It will also be pointed out how the results of completing these tasks helped shape the final project products.

Reviewing Relevant Literature to Establish a Knowledge Base

In preparing the proposal for the project, a brief review of the literature had been completed. As a first step in completing the project once funded, a more extensive literature review was begun. The purpose for this review was to ensure that project staff had an understanding of what was actually being done or written in the areas of energy, environmental, vocational, and adult

education. This literature came from several sources:

- Information sent in response to a letter to all state directors of vocational and adult education inquiring about the activities of their states in energy and environmental education.
- ERIC documents in the areas of post-secondary vocational and adult education, energy production, energy conservation, and environmental education.
- Instructional materials on these topics produced by utilities, public interest groups, etc.

A bibliography of the most relevant of this literature is included with this report and in the Resource Book. Based on this literature review, staff members developed the following conclusions described in the remainder of this section. These conclusions along with the organizing perspectives described earlier provided the basis for the design of the Model. A large number of documents on energy and environmental topics, many of which were semi-technical in nature, were also reviewed in order to develop the energy content of the Model. This literature is not reported here, but is instead included in one of the project's products: The Resource Book.

First of all, there was still a great deal of confusion over the meaning or domains of energy education, environmental education, and energy conservation. The results of a survey of pre-college curricula conducted at the Energy Research Institute of the University of Houston characterized energy education in the following way:[8]

- Energy education materials tend to stress technical topics.
- They do not adequately stress policy issues and the political and economic milieu in which controversial policy issues are resolved.
- They often lack consistent core themes and adequate conceptual framework.
- They provide little that is useful in the development of an alternative energy ethic.

Although this study was limited to pre-college curricula, based on the experience of the project staff in reviewing curricula and materials at the secondary level, the same conclusions were generalizable to the post-secondary level as well. In other words, energy education programs or materials were typically technical in nature, providing students with a great deal of information about the advantages and disadvantages of various energy technologies. In energy texts, issues related to energy conservation or environmental quality were often addressed only in a secondary fashion.

On the other hand, materials oriented toward energy conservation had a special perspective of their own. Frequently, though not always, they dealt with ways to reduce consumption of energy in homes, automobiles, or school facilities. There was little discussion of how these efforts related to broader issues of energy production and utilization. When these were discussed, it was usually in terms of solar energy as the solution to our energy problems. Although most of the suggestion contained in these materials could be quite useful, it seemed unlikely that these strategies would in the long run solve our nation's energy problems, nor would they necessarily or by design address issues of environmental quality.

Yet, within the energy field itself there were a number of theorists who were giving a broader meaning to the term energy conservation. Many energy experts such as Lee J. Schipper[9] and Amory Lovins[10] and members of the California State Energy Commission[11] were pointing out that energy conservation required considerations of not only how much energy we were using, but also on how well we were using it through all sectors of the economy. These writers were saying that energy conservation entailed the wise use of all energy resources, not just simply reducing our energy demands or converting to solar energy. To use energy wisely or better requires that all energy resource

production and utilization technologies be examined to determine where energy can be saved and to understand the effects of these technologies on the environment as well as the equitable satisfaction of human needs.

This broader view of energy conservation which included consideration of environmental quality was quite consistent with project staff members' initial organizing perspective on the specification of content on environmentally related topics. It was clear that a strong distinction between general energy education and energy conservation education should not be made and that both topics were clearly related to environmental quality. Thus, for ease, project staff decided to focus on the topic of energy conservation in order to solve the problem of always having to refer to energy conservation and environmental quality or vice versa. Further, project staff understood that a comprehensive model would have to include considerations of environmental quality. The question still remained, however, as to how to incorporate these notions into an understandable curriculum model.

A third generalization from the literature review related to this need for an understandable curriculum model. One needed only to review the January 1 issues of Library Journal for the years 1977-79 to obtain an overview of the plethora of materials being published on energy-related topics.[12] Many of these were not highly technical in nature and were suitable for classroom use. In particular, the Library Journal referenced many materials produced by public utilities, public interest groups, government agencies, professional and trade associations; most of these are available free or at low cost. These materials, however, were basically narrowly-focused on a particular topic or contained general information and a great deal of facts and data. Very little was being produced targeted for educational practitioners with limited energy or environmental background to give them a broad perspective and understanding of energy conservation.

Materials typically found in ERIC were also of limited value in providing educators with an understanding of energy conservation. These ERIC materials usually consisted of sample lesson plans for students and bibliographies of energy materials. In the staff's review of the literature, only one document could be found that was clearly aimed at educators with the intent of providing them an overview of the energy and energy conservation domain. This document found in ERIC was produced by the New Jersey State Department of Education, and included a model targeted at K-12 teachers.[13] The purpose for the document was to give the teacher an orientation to energy education and the encouragement to do research and teaching beyond the initial condensed content of the model.

To be sure, some effort was being made to provide educators with training in these areas. Agencies such as the Office of Environmental Education and the Department of Energy were beginning to sponsor workshops and institutes on the environment and energy. These too, however, often focused on a particular topic and, at best, could be attended by only a relatively small number of people.

Lastly, the review of the literature in the area of vocational education was particularly revealing of what this group perceived as its role at the post-secondary level in coping with our energy problems. The 1977 report by the National Advisory Council on Vocational Education, "The Response of Vocational Education to the Energy Crisis," seemed to indicate that the major response of vocational education should be the development of curriculum in energy-related technologies such as nuclear, petroleum, coal, etc.[14] The report further indicated that in 1976 more programs were being developed or planned in solar technology than any other energy technology. Once again, energy conservation was seen as something separate from education in the

various energy technologies.

Other vocational education literature such as the guide published by the Morraine Park Board of Vocational, Technical, and Adult Education in Wisconsin were useful in pointing to a second area in which vocational education should take a role.[15] Although specifically addressing environmental issues, the guide pointed out that areas such as auto mechanics and home economics were important areas for the incorporation of environmental concepts--areas which were not directly related to environmental technology. More recent articles in the January, 1979 issue of The Journal of the American Vocational Association also pointed to this role.[16] Energy use concepts could, for example, be incorporated into the agricultural curriculum. One result of this may be the energy conservation technician: a person who is competent in the established skills required for existing occupational areas, but who is also competent in assessing and developing techniques to better use energy.

In 1974, Albert J. Riendeau, Chief of the Post-Secondary and Adult Occupational Programs Branch also pointed to a third role for vocational education in meeting the energy crisis.[17] He indicated that vocational educators must not only help prepare technicians for energy fields, but must also assist in the process of changing attitudes. Others writing about solutions to our nation's energy problems in a societal context have expanded upon this theme.[18] It has been pointed out that all workers need to understand the importance and principles of energy use and its relationship to their respective occupations.

To the project staff it was this third role which had the greatest ramifications for all of vocational and adult education and for the present project. All vocational education programs should help train workers to have a basic energy awareness and literacy. Indeed, without this perspective, it is conceivable that students could be trained effectively in an energy technology,

such as solar energy, and at the same time the students could be unaware of the broader issues of energy conservation.

This review of the literature, then, and the generalizations drawn from it were useful in helping to direct model design activities. Project staff had a much clearer perspective on the purpose the curriculum model was to serve and to whom it should be directed. That is, the model should be directed at providing vocational educators with a framework so that they could develop a comprehensive understanding of energy conservation. Alternatively, it could be directed at curriculum designers who develop programs and materials for the training of educators in specialized vocational fields. Based on this understanding, vocational educators could introduce energy conservation content into their programs. Further, the model should be oriented toward vocational education in general rather than a specific occupational field. The model should, however, provide a basis for development of instructional programs for educators in specific occupational settings.

Specification of Content Areas to be Included in the Model

Based on the original purpose of the project, the organizing perspectives, and the literature review, project staff began the task of designing the curriculum model. The first step in this process was the specification of the target audience to whom the model would be directed. As indicated earlier, it was decided that the appropriate target audience was vocational and adult educators. In designing the Model, three assumptions were made with respect to the potential users. First of all, users must have a positive attitude toward approaching energy conservation. Secondly, they must be competent in

their subject areas. Thirdly, users must be competent in developing, implementing, and evaluating instruction at the level for which they have responsibilities.

The most important aspect of the design process was the specification of content areas to be included in the Model documents. To do this it was necessary to integrate the design parameters as described in the previous sections and energy concepts and principles.

Content areas, and not competencies in the instructional sense, were specified. The reason for this was that the Model and its supporting documents were to be a map of the energy conservation territory and to be used as a basis for curriculum or program staff development. The documents to be produced were, therefore, not instructional materials, but to be used as the basis for developing instructional materials or programs. In this sense, then, the Model was actually being targeted for use by program and material designers who would utilize the approach specified in the Model in developing staff training programs in particular instructional settings. The Model itself was not the "ideal" or "exemplary" program, but a generic representation of what should be included in developing programs based on a comprehensive understanding of energy conservation.

Based on the review of the literature on energy and environmental topics, content areas were selected on the basis of what should be included in the model if the user is to understand energy conservation in its broadest context (e.g., how to use energy resources wisely). Many of these content areas were derived from the initial conceptual model which was an organizing perspective for the project. These content areas are specified in Figure 3.

Figure 3

Energy Conservation Model Content Areas

Model content should be relevant to helping the educator become familiar with or understand the following:

- The components of the Model and the role of each.
- The conceptual framework for the Content Model as one way to gain an overall perspective on the relationship between human and natural systems and "how to think about conservation."
- The importance of energy conservation for entire vocational field.
- The broader interpretation of energy conservation as the wide use of energy resources and its relationship to a stewardship worldview.
- The various energy futures being predicted for us and the choices we have with respect to these futures.
- The importance of the equilibrium of ecosystems.
- The basic laws governing energy flows.
- The nature of various energy resources.
- The impact of energy production or utilization on ecosystem equilibrium.
- The basic utilization principles relevant to the appropriate use of energy (e.g., scale, efficiency, energy quality, net energy).
- The delivery systems associated with each of the various energy technologies.
- The ways in which the uses of energy are related to human need satisfaction (e.g., health, shelter, jobs) and that energy conservation may result in the satisfaction of needs in valued ways.
- The need to conserve energy has the potential to improve the quantity and quality of jobs.
- The wide range of jobs that are related to energy conservation.
- The ways conservation can be infused or integrated into almost any subject skill area.
- The new courses that may be developed around energy conservation topics
- The wide variety of references or information resources that are available related to energy topics.

Organizing the Content for Product Development

Once the content areas had been specified it was necessary to organize the content providing the initial specifications for the development of the Model documents. One of the factors which aided this process was the perspective taken initially by the project staff concerning what is needed in systematic curriculum development. Based on this perspective, then, several documents had to be designed and developed as logical and necessary components of the model. These were the following:

- Orientation Guide. The purpose of this Guide is to orient the reader by describing the rationale for the Model and its component documents. The Guide addresses the question, "why does the educator need to know about energy conservation?"

- Curriculum Content Model. The purpose for the Content Model is to map out the knowledge areas relevant to a comprehensive understanding of energy conservation. The Content Model addresses the question, "what does the educator need to know to develop a comprehensive understanding of energy conservation?"

- Resource Book. The purpose for this document is to further describe the knowledge areas in the Content Model and to describe learning resources useful in acquiring an understanding of this content. The Resource Book further addresses the issue of what the educator needs to know for a comprehensive understanding as well as the question, "what learning materials and resources are useful in acquiring this understanding?"

- Application Guide. The purpose of this document is to describe and suggest ways that the entire Model could be used as a basis for integrating energy conservation into existing courses or developing new courses. The Guide addresses the question, "what types of instructional and learning arrangements are needed to transmit this understanding to the educator's student?"

Although the questions to be addressed remained the same, the final set of documents was a slight variation of those the project had originally intended to produce. When the project started, it was intended to develop both a Sourcebook elaborating on the knowledge components of the Model, and a Reference Manual providing an extensive bibliography. As the project work progressed, it seemed much more logical to produce only one document, a

Resource Book, with two sections to it. One section was devoted to an elaboration of the knowledge components of the Model, and the other contained a bibliography of information materials and resources.

In addition, it was originally proposed to develop a Curriculum Management Manual providing specifications for purposing, planning, implementing, and evaluating an energy conservation course. A Micro-Instructional Unit was also to have been developed as a representation of a unit of instruction in this area. As the project progressed, it became clear that what was needed was not so much a document on classroom instructional techniques, but a document describing how the Model might be applied in a variety of settings. Thus, a decision was made to alter slightly the purpose for the original Curriculum Management Manual and to produce instead an Application Guide. A Micro-Instructional Unit was not produced; instead, several instructional examples were included in the Application Guide.

Of these documents, the Curriculum Content Model was clearly a "key" document. To facilitate presentation of content, the conceptual framework from which many of the content specifications had been derived was used as framework for the Curriculum Content Model. Using this, project staff had a basis for both selecting and organizing content or subject matter with respect to energy conservation. The following figure (Figure 4) illustrates the generic content themes that were specified in each of the sectors of the framework presented earlier in the chapter in Figure 2.

As presented in Figure 4, to develop a comprehensive understanding of energy conservation at the operational level requires the examination of (a) how human needs are satisfied, (b) by using a variety of technologies to produce and use, (c) natural system resources. At the conceptual level, how we approach energy conservation depends upon (f) our values for the present

Figure 4

THEMES OF THE ENERGY CONSERVATION CURRICULUM CONTENT MODEL

	NATURAL SYSTEMS	INTERACTIONS	HUMAN SYSTEMS	
OPERATIONAL	resources (a)	technologies (b)	human needs (c)	OPERATIONAL
CONCEPTUAL	laws and functions (d)	energy conserving utilization concepts (e)	values and the future (world views) (f)	CONCEPTUAL

and future (worldviews) and our understanding of (e) energy utilization concepts and (d) the laws and functions of ecosystems. A more detailed elaboration of these content areas is provided in the Curriculum Content Model document and in the Resource Book.

Almost all of the content areas originally specified could be incorporated within the Curriculum Content Model. The remaining content areas formed a logical basis for development of the remaining project products. As indicated earlier, in addition to the Curriculum Content Model, these were the Orientation Guide, Resource Book, and Application Guide. The following figure presents the original list of content areas and the document(s) which address each of these areas.

This organization of the content areas provided a basis for development of each of the documents. A draft version of these documents was reviewed by a group of San Francisco Bay Area post-secondary adult and vocational educators.

Figure 5

CONTENT AREAS INCLUDED IN EACH MODEL DOCUMENT

CONTENT AREA	MODEL DOCUMENT*			
	A	B	C	D
• The components of the Model and the role of each.	X			
• The conceptual framework for the Content Model as one way to gain an overall perspective on the relationship between human and natural systems and "how to think about conservation."		X		
• The importance of energy conservation for entire vocational field.	X			
• The broader interpretation of energy conservation as the wide use of energy resources and its relationship to a stewardship worldview.	X	X	X	
• The various energy futures being predicted for us and the choices we have with respect to these futures.			X	
• The importance of the equilibrium of ecosystems.			X	
• The basic laws governing energy flows.			X	
• The nature of various energy resources.			X	
• The impact of energy production or utilization on ecosystem equilibrium.			X	
• The basic utilization principles relevant to the appropriate use of energy (e.g., scale, efficiency, energy quality, net energy).			X	
• The delivery systems associated with each of the various energy technologies.			X	
• The ways in which the uses of energy are related to human need satisfaction (e.g., health, shelter, jobs) and that energy conservation may result in the satisfaction of needs in valued ways.			X	
• The need to conserve energy has the potential to improve the quantity and quality of jobs.			X	
• The wide range of jobs that are related to energy conservation.			X	
• The ways conservation can be infused or integrated into almost any subject skill area.				X
• The new courses that may be developed around energy conservation topics				X
• The wide variety of references or information resources that are available related to energy topics.			X	

* A = Orientation Guide
B = Content Model
C = Resource Book
D = Application Guide

On the basis of this review, these documents were revised. The revised set of Model documents accompanies this report.

The next chapter describes the remaining project objectives. Evaluation of the Model was one of those objectives.

CHAPTER THREE

REMAINING PROJECT OBJECTIVES: PROCEDURES AND RESULTS

In addition to the tasks associated with design and development of the Model and Model-related documents, project staff were involved in tasks related to three other technical objectives. These objectives were to:

- develop a knowledge base regarding specific programs into which the Model could be integrated;
- evaluate the Model; and
- disseminate information about the Model.

In this chapter, the procedures and results associated with each of these will be described.

Develop a Knowledge Base Regarding Specific Programs into Which the Model Could be Integrated

Several activities were carried out with respect to this objective. First of all, a letter was sent to all state directors of adult and vocational education asking them about the activities of their respective states in energy and environmental education. A copy of this letter is in Appendix A. Secondly, throughout the project, regular contacts were made with organizations and institutions developing training programs in energy-related vocational areas. Lastly, publications and information sources describing training programs were reviewed on a regular basis.

From this information, it became clear that a great deal of activity was taking place within vocational education, in particular in the development of training programs in energy-related areas. In 1976, for example, as reported in "The Response of Vocational Education to the Energy Crisis,"

30 programs were being developed in solar technology and 13 in energy conservation.[19] In a January 1979 report on energy-related training activities, over 150 solar technology courses were being planned or implemented and over 110 in energy conservation.[20] The over 30 responses to the letter sent by the project to the state directors also indicated this same flurry of activity.

As indicated earlier, what seems to characterize these programs or curriculum development activities is the notion that energy conservation is a technology separate from energy-related fields or that the development of alternative energy technology training programs is inherently attending to the need for energy conservation. These are, of course, generalizations based on the brief descriptions available on these programs that warrant further study.

Confirmation on this generalization, however, did come from several discussions project staff members had with local vocational educators. One person reported that the institution he represented was doing something in the area of conservation: the school was developing a solar technician training program. There was, however, little evidence that conservation topics were included in the curriculum. Another person reported that his school was not going to deal with conservation until there was a job demand for persons in this field.

These sentiments, although quite understandable, were disturbing to project staff who felt that energy conservation should be of concern to all workers. Everyone can play a role in better using energy on the job and at home. In order to convey this idea, model documents were written at a general or generic level with content focused on how conservation was the concern of everyone. A rationale for energy conservation in vocational education was also included in the Orientation Guide. Further, the Application

Guide contained examples of how the Content Model could by design be integrated into or used as a basis for developing a variety of courses. These examples were introductory auto mechanics, introduction to solar energy, energy conservation as a course for the adult learner, and an energy and careers unit.

Thus, although the original intent was to obtain information about specific programs into which the Model could be integrated, it became clear as the project progressed that the Content Model was relevant to all occupational programs. The project documents were developed to illustrate how this could be done. It should be pointed out, however, that the products are only a generic model or a representation of what could be done. To be most effective in a particular occupational area, the documents should be developed one stage further. Although the generic concepts and relationships in the Model would not change, to be most useful they should be translated (e.g., explained) into the context of a particular occupational field. This was not, however, the purpose for this initial generic model development project.

Evaluation of the Model

Three major activities were carried out to evaluate the Model and the Model-related documents. Each of these had a particular focus as evaluation activities were carried out in three phases. The first phase was designed to obtain information about the appropriateness of the project approach to model development and the correspondence between the rationale and the proposed model documents. The project's Advisory Panel was involved in this evaluation activity. The purpose of the second set or phase of evaluation activities was to obtain information about the utility and comprehensibility of a draft version of the Curriculum Model documents. Six Bay Area vocational and adult educators

were involved in this review.* The purpose for the third set of evaluation activities was to obtain information concerning the willingness of the potential target group to use and to incorporate into their programs energy conservation concepts as presented to them in condensed versions of the Model documents. Participants in the workshop held near the end of the project participated in this activity. Each of these evaluation activities will be described in more detail in the following sections.

Advisory Panel Review of Project Approach. The purpose of this first phase was to have Advisory Panel members assess the appropriateness of the project's approach and subsequent correspondence between the rationale and the proposed set of model documents. In other words, the project was interested in finding out if the Panel agreed with, first of all, the project's assessment of the importance of an energy literate citizenry and its relevance to adult and vocational education and secondly, the degree to which initial design of the proposed curriculum model documents met the project's purpose. To address these concerns a working paper (included in Appendix B) providing the approach and rationale of the project was sent to each member prior to their February 27, 1978, meeting. This paper served as a starting point for the review. At the meeting each person was also given a first draft of the Curriculum Content Model and an outline of the remaining documents.

Based on the discussion of the Advisory Panel, several conclusions were made by project staff. First of all, the comprehensive, holistic approach to the issues of energy conservation and environmental quality was applauded. Three of the Panel members were in general agreement that this understanding should be of concern to both adult and vocational educators. One Panel member expressed concern that there may be no job market for people with broad understanding of energy conservation and for this reason would not appeal to occupational educators. The Panel agreed with the purpose and format for the Curriculum Content Model and Resource Book as it was presented to them in outline form. A recommendation was made to address more specifically the relationships between health and jobs. The Panel was most concerned about how these potentially valuable materials were to be distributed. In response to this, project staff members outlined their dissemination strategies and agreed to file the product in ERIC.

---

*See Acknowledgments for the names of these reviewers.

Model Documents Review. The purpose of the second review phase was to have a representative sample of potential users assess the utility and comprehensibility of the model documents. Hence, six Bay Area adult and vocational educators, four of whom were administrators, were sent the first draft of the Model documents (with the exception of the Application Guide) along with a set of the following review questions:

- Do each of the documents accomplish the task or purpose as specified?
- Is the content presented in each document comprehensible?
- Is the content appropriate for intended users?
- In what ways could you utilize the materials?
- What suggestions do you have for revision?

A separate meeting with each of the reviewers was held between October 30 and November 15, 1979, to address these questions.

Overall, the reviewers acknowledged the utility of the documents to educators already interested or involved in some form of energy or environmental education. The vocational education reviewers, in particular, felt that the odel was perhaps too general in nature and written with a higher reading level than most vocational educators were accustomed to. They suggested that formats similar to Army and Navy training materials were generally more acceptable to vocational educators. In regard to the Orientation Guide, specifically, they suggested that it should contain more materials further elaborating on the relationship of vocational education to energy conservation and suggesting how the documents might be used. Reviewers of the Curriculum Content Model were generally impressed with its comprehensiveness. They suggested that an outline format as well as a graphic presentation of the Model content would be useful. With respect to the Resource Book, most reviewers were impressed with the text presentation and resources. Suggestions for elaboration of certain concepts were made.

Overall, then, the evaluation of these documents was favorable in nature. Most of the suggestions for revisions were used in developing the final products. Although the Orientation Guide was revised to further indicate the relevance to vocational education, because of the purpose of the project to design a generic model, it was not possible to adopt an Army or Naval training materials format. Indeed, the Model is not intended to be used as a training or instructional device. Development of a targeted set of training materials would be the next logical step in development of the Model. On the basis of reviewers' comments, it was decided, however, to illustrate in the Application Guide the potential useability of the Model to develop courses around energy conservation topics or to integrate energy conservation into already existing courses. This was done in two ways. First, general guidelines for integration or new course development were presented, and then specific examples of courses were described.

Workshop Review of Model. The third and final evaluation of the Model was conducted near the end of the project. This evaluation was conducted at the California State Department of Education's Annual Conference for Industrial Education. Approximately 25-30 persons, mostly classroom instructors, attended the workshop at which the concepts in the Curriculum Content Model and a resource list were presented to participants. Time was then spent explaining infusion or course development strategies around the concepts and issues. At the end of the workshop, participants were asked to complete a short questionnaire; fifteen persons did so. The questions and results are presented in the following table.

TABLE 1

Workshop Evaluation Results

1. Do you see the importance for integrating conservation concepts into your classroom?

1 (80%)	2 (7%)	3 (13%)	4 (0%)	5 (0%)
Yes		Somewhat		No

2. Did you understand the process for integrating energy conservation into occupational curricula?

1 (47%)	2 (40%)	3 (13%)	4 (0%)	5 (0%)
Yes		Somewhat		No

3. Can you see how this process might be applied to your own curriculum?

1 (33%)	2 (27%)	3 (33%)	4 (7%)	5 (0%)
Yes		Somewhat		No

These results indicate that this group did perceive the importance of energy conservation and did indeed understand the overall curriculum content focus. (It should be noted that at the time, the "Iranian" gasoline crisis was very much in the news.) Although they understood the process in general, they were less confident that it could be applied to their own subject areas. One explanation for these results could be that in a short workshop there was insufficient time to fully explore applications to individual subject areas. The most likely explanation, however, is that materials should be developed targeted to the various occupational subject areas. Again, this is the logical next step in applying the model.

There was one final activity that was in some senses an evaluation of the model and of the approach of the project to energy conservation. This was the activity undertaken by the Community College instructor who worked closely with the project particularly in its early stages. The instructor was in the Adult Education math and science program of the Pacific Heights Community College Center. Using the energy and environmental references available to the project and interacting with project staff to explore energy conservation concepts, he developed on his own a Teachers' Energy Guide for the San Francisco Community College Centers. The energy map which he used as a guide contained many of the same thematic elements as in the Energy Conservation Curriculum Content Model. His elements are People, Values, Technology, Strategies, Resources, and Natural Laws. This was, of course, not unanticipated but does indicate that the generic Model and approach can be adapted for specific applications. A complete copy of his guide is in Appendix C. It was made available to the Community College Centers' instructors at an Energy Workshop held by the Centers. This was perhaps the most relevant evaluation of the Energy Conservation Curriculum Model.

Disseminate Information About The Project

Several activities were carried out to disseminate information about the project. An information letter was designed to be sent in response to information requests. A copy of this letter is included in Appendix D. In addition, at the end of the project, the model was presented in a workshop at the California State Department of Education's Annual Conference for Industrial Educators. Materials relevant to this workshop are included in Appendix E. The conference was also attended by educators in other fields of vocational education.

An information package containing essentially the Orientation Guide was also sent to all state directors of vocational and adult education. A copy of this package is included in Appendix F. Finally, the Model documents will be dubmitted to the ERIC system. This dissemination objective and the activities associated with it were the final set of activities undertaken by the project.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

As a result of project activities several conclusions and recommendations can be made:

1. Energy conservation is indeed relevant to all adult and vocational fields. All workers and all citizens must be energy literate. Based on project members' experience with vocational educators, in particular, it would seem that to many energy conservation is of concern only if there is a labor market or demand for a person skilled in this area, or that energy conservation is accomplished by developing alternative energy resource training programs. Although these programs (such as solar energy) may contribute to energy conservation, unless energy conservation concepts are introduced by design, these programs will not necessarily result in energy literate workers. Moreover, energy conservation should be of concern to programs outside of energy technology as well. The vocational leadership community could play a stronger role in pointing out this relationship to the vocational education community and in developing curriculum materials in this area.
2. An Energy Conservation Curriculum Model was produced by the project to facilitate incorporation of energy conservation by design into post-secondary adult and vocational education. Concepts relevant to understanding relationships between energy and environmental quality, energy and human need satisfaction, as well as energy resources and energy technologies are integral components of the Curriculum Content Model.

3. The Model and its related component documents were generally perceived by the field to be comprehensive, comprehensible, and useful. There are still questions as to how relevant they will appear in their generic form to vocational educators. The Model and the Model-related documents were, however, designed specifically to be generic in nature. The next logical step in their development is to adapt them to a specific context such as auto mechanics, solar technology, home economics, etc. In so doing, the language of the particular field would be used to explain and illustrate the concepts in the generic Model. The Model was purposely written at a generic level so that this transformation into specific instructional programs for educators could be accomplished by design at a future time.

4. Many potential useable energy conservation related materials are available free or at low cost to educators. The Curriculum Model was designed, in part, to provide a conceptual framework so that these materials could be used most effectively. Alternatively, the Model provides a conceptual base for development by instructors of their own targeted materials. Additional in-service or pre-service training is undoubtedly required in order to provide educators with this conceptual base. In conducting in-service training the emphasis should be more on providing educators with a conceptual framework or way to view and understand energy conservation, and less on giving them data or student materials. There are undoubtedly other ways the Curriculum Model could have been designed. This was simply one effort to develop a comprehensive conceptual framework. This framework or another one comprehensive in nature and intent should be the starting point for much-needed staff development activities.

FOOTNOTES

1. John M. Fowler and King Kryger "Emerging Vocational Education," Voc Ed, 54, 1 (January, 1979), 41-43.

2. Environmental Education Act (PL 91-516 as amended by Public Law 93-278).

3. "Editorial," Social Education, 32,2 (February, 1975), 72-73.

4. Paul Campbell, Robert Feldmesser, Donald Raske, and Hessy Taft, Content Analysis and Interpretation of Five Regional Hearings Conducted by the Education Testing Service to Determine Current Status and Future Needs of In-School Energy Education (Princeton, NJ: Educational Testing Service, 1976).

5. Campbell and others, 1976.

6. Bela Banathy, Developing a Systems View of Education: The Systems Model Approach (Belmont, Calif.: Tearon Publishers, 1973).

7. Bela Banathy and others, The Environmental Education Teacher Training Model: Content Sourcebook (San Francisco: Far West Laboratory for Educational Research and Development, 1978).

8. Robert M. Jones and John E. Steinbreak, A Survey of Pre-College Energy Education Curricula at the State Level (Houston, Texas: Energy Institute, University of Houston, 1977), p. 8.

9. Lee L. Schipper, "Energy Conservation: Its Values, Hidden Benefits and Hidden Barriers," Energy Communications, 2,4 (1976), 331-416.

10. Amory Lovins, Soft Energy Paths: Toward A More Durable Peace (San Francisco: Friends of the Earth, 1977).

11. California Energy Commission, 1977 Biennial Report, Vol. 3, Opportunities for Energy Conservation (Sacramento, CA: State of California Energy Commission, 1977).

12. The January 1 issues of the Library Journal for 1977, 78 and 79 are devoted to energy and contain lengthy bibliographies of energy materials and information resources.

13. Bruce Campbell, (compiler), Energy and Education Handbook (Trenton, NJ: New Jersey State Department of Education, 1977).

14. National Advisory Council on Vocational Education, The Response of Vocational Education to the National Energy Crisis (Washington, D.C.: The National Advisory Council on Vocational Education, December, 1977).

15. Morraine Park Board of Vocational, Technical, and Adult Education, Guide for Integrating Environmental Education Concepts into Elementary, Secondary and Post-Secondary Vocational, Technical and Adult Education (Fond du Lac WI: Morraine Park Board of Vocational, Technical and Adult Education, 1974).

16. Voc Ed, The Journal of the American Vocational Association, 54, 1 (January, 1979).

17. Albert J. Riendeau, Post-Secondary Technical Education and the Energy Crisis, ERIC Document 109 447.

18. See for example the sections on "Jobs and the Environment" and "Energy" in Progress as If Survival Mattered, ed. Hugh Nash (San Francisco: Friends of the Earth, 1977).

19. National Advisory Council on Vocational Education, p. 6.

20. Daniel M. Hull, Curriculum for Energy Use and Conservation Technicians Waco, Texas: Technical Education Research Centers, Inc., Southwest Center, 1979). Report No. 78-63-02B prepared for the U.S. Department of Health, Education and Welfare.

BIBLIOGRAPHY*

Banathy, B. Developing A Systems View of Education: The Systems Model Approach. Belmont, CA: Fearon Publishers, 1973.

Banathy, B., Others. The Environmental Education Teacher Training Model: Content Sourcebook. San Francisco: Far West Laboratory for Educational Research and Development, 1978.

California Energy Commission. 1977 Biennial Report. Sacramento, CA: State of California Energy Commission, 1977.

Campbell, B. (Compiler). Energy and Education Handbook. Trenton, NJ: New Jersey State Department of Education, 1977.

Campbell, P.; Teldmesser, R.; and Taft, H. Content Analysis and Interpretation of Five Regional Hearings Conducted by the Educational Testing Service to Determine Current Status and Future Needs of In-School Energy Education. Princeton, NJ: Educational Testing Service, 1976.

Clinard, L. "Conservation--We Have Met The Enemy!" VocEd, 1979, 54, 1, pp. 35-37.

Doggette, J.R. Energy-Related Technology Programs in Community and Junior Colleges: An Analyses of Existing and Planned Programs. Oak Ridge, TN: Oak Ridge Associated Universities, 1976.

"Editorial." Social Education, 1975, 32, 2, pp. 72-73.

Energy Technology Training Conference Proceedings. Co-sponsored by the U.S. Energy Research Development Administration and the American Association of Community and Junior Colleges. Oak Ridge, TN: Oak Ridge Associated Universities, 1976.

Fowler, J.M.; and Kryger, K. "Energizing Vocational Education, VocEd, 1979, 54, 1, pp. 41-43.

Hull, D.M. Curriculum for Energy Use- and- Conservation Technicians (Report 78-63-02B). Waco, TX: Technical Education Research Centers, Inc., Southwest Center, 1979.

Lovins, A. Soft Energy Paths: Toward A More Durable Peace. San Francisco: Friends of the Earth, 1977.

McCabe, R.H. (Ed.). Current Issues in Environmental Education-III. Columbus, OH: The ERIC Center for Science, Mathematics, and Environmental Education, 1976.

Moore, Allen B. Energy Problems Provide Job Opportunities. Columbus, OH: Center for Vocational Education, 1977.

*For a more complete bibliography of the references used in developing the content of the Energy Conservation Curriculum Model, see the various Model-related documents.

Morraine Park Board of Vocational, Technical, and Adult Education. Guide for Integrating Environmental Education to Elementary, Secondary, and Post-Secondary Vocational, Technical, and Adult Education. Fond du Lac, WI: Morraine Park Board of Vocational, Technical, and Adult Education, 1974.

Myron, G.A." Energy Conservation Education and the Community College," Community and Junior College Journal, 1977, 48, 3, pp. 6-19.

Nash, H. (Ed.). Progress As If Survival Mattered. San Francisco: Friends of the Earth, 1977.

National Advisory Council on Vocational Education. The Response of Vocational Education to the National Energy Crisis. Washington, DC: National Advisory Council on Vocational Education, 1977.

National Field Research Center, Inc. A Plan for Environmental/Energy Education in The Public Community College System of Illinois. Iowa City, IA: National Field Research Center, Inc., 1975.

Olympus Research Corporation. Career Education in The Environment: A Handbook. Prepared for the Regional Commissioners Conference on Career Education in the Environment for the Division of Vocational and Technical Education, United States Office of Education, 1971.

Rideneau, A.J. Post-Secondary Occupational Education and the Energy Crisis. Paper presented at the Annual Conference on Community College Occupational and Technical Education, Blacksburg, VA, 1974.

Roth, R.E. A Review of Research Related to Environmental Education, 1973-1976. Columbus, OH: The ERIC Center for Science, Mathematics, and Environmental Education, 1976.

Schipper, L.J. "Energy Conservation: Its Nature, Hidden Benefits, and Hidden Barriers." Energy Communications, 1972, 2, pp. 331-414.

APPENDICES

APPENDIX A:
Letter sent to State Directors
of Vocational and Adult Education

FAR WEST LABORATORY
FOR EDUCATIONAL RESEARCH AND DEVELOPMENT

October 17, 1977

For the past two years, Far West Laboratory has been involved in the area of energy/environmental education. Our current group of projects includes a grant from the Office of Education's Bureau of Occupational and Adult Education. The purpose of this project is to develop an energy/environmental education curriculum model appropriate for post-secondary adult and vocational educators.

As part of our activity for this project, we would like to compile documents from each state that reflect the vocational and/or adult education plans or needs of the state with respect to energy and environmental education. We are interested not only in reports of specific technology-related training programs, but also in documents that describe the concerns and needs of vocational/adult education at the state level.

We would appreciate it if you could send us or refer us to any documents that describe your activities in this area. If you already have an ongoing adult or vocational curriculum activity related to energy and environmental education, we would appreciate receiving the name of an appropriate person who we could contact for more information.

Thank you for your help. If you have any questions, please call me at (415) 565-3026. The last phase of our activity includes disseminating information to each state concerning our curriculum model; thus, we will keep you informed about the progress of our project.

Sincerely,

Jacqueline E. Haveman
Sr. Program Associate
Instructional and Training
Systems Program

JEH/cb

P.S. For your convenience, we are enclosing a postage-paid self-addressed mailing label.

1855 FOLSOM STREET • SAN FRANCISCO, CALIFORNIA 94103 • (415) 565-3000

APPENDIX B:

Working Paper for
Advisory Panel

(Post Secondary Energy Curriculum Model Project)

Introduction

The general goal for this project is to design and develop a curriculum model for energy conservation at the post secondary adult and vocational education level. We feel it is important to deal with this subject area because environmental and energy concerns have an impact on life style and career decisions. Likewise, collectively, our life style and career decisions can effect how successfully we deal with environmental and energy concerns.

In order to provide a focus for our activity, we have decided to emphasize energy and energy conservation in the design of our curriculum model. There are several reasons for this.

1. Energy is a current national and world issue. Important decisions concerning energy futures will be made within the next few years. These decisions will have implications for each of our lives at the national as well as personal level.
2. Despite the fact that energy is a concern to most world leaders, various surveys indicate that the majority of the general public does not believe that an energy crisis exists. Or, it can be suggested that they do not understand the nature of the energy dilemma. As a result, they may not be able to participate knowledgeably in the decision making process.
3. Activities in the energy area concerns are directly related to many key environmental issues, such as pollution, land use, and job safety. By dealing effectively with energy we should also be taking steps to maintain and to preserve the quality of the environment.

In attempting to develop our model there are a number of questions with which we must deal:

- What do educators think about energy education and what do they think energy education should do?
- What kinds of courses and materials are now being developed and offered related to energy areas?
- What primary sources are we using to understand key concepts in understanding energy and its relationship to life styles and career choices?
- What implications do answers to the above question have for our project activities? How do we best present this understanding to teachers?

At this point in the project, we have not been able to answer all of these questions. We have, however, arrived at some tentative conclusions which we would like to serve as a basis for our discussions.

Educator's views of Energy (Education)

Following are some quotations from various educators regarding the energy dilemma and its relationship to education.

U. S. Commissioner of Education, Ernest L. Boyer (Today's Education):

> Schools must conserve. They must contribute to the training of workers in the new energy and environment fields. And they must teach our children and ourselves about the wider nature of the energy dilemma and must equip our society with the understanding necessary to remake our society in the light of that dilemma... We must see more clearly and understand more completely the unity of our world, not just in a physical senses but in a social sense as well. We must constantly remind ourselves that no thing is ever wholly destroyed and that all our moves on this planet--whether physical or social--are intimately interlocked.

Albert J. Rideneau (Chief, Post Secondary Education Branch)

> If community colleges, technical institutes, trade and technical institutes, trade and technical schools and other two-year post-secondary institutions, both public and private, are to make their greatest contribution during the period of limited energy resources, they must not only help prepare thousands of technicians and skilled persons for energy fields, but they must assist in the process of changing attitudes.

Charles A. Whitehead, Vice President of the Technical Education Division of the American Vocational Association;

> The energy dilemma... will cause drastic changes in the roles and responsibilities of technical education... It must; first, find or develop a change in the expertise among its own faculty and staff; second, retool many of its own shops and laboratories, third, revise curricula to produce the qualified worker for the new jobs and new tasks... I do knwo that changes brought about by the energy dilemma will be only as effective as the operator, the craftsman, the serviceman, and the paraprofessional can make them.

Speaking primarily about industrial arts program but generalizing to the broader issue of vocational training, Kendall N. Starkweather:

> Future oriented industrial arts programs will consider technological systems existing in the entire world through an interdisciplinary approach to educaiton. [This] may require a change of emphasis on the type of content to be taught. Instead of placing major emphasis on how to become a skilled machine operator, the trend will be to organize content around issues and problems associated with technology and society... Future oriented industrial arts will lend itself more readily to the application of technology in the solution of major problems facing [man] kind (sic). Major technological issues power/energy systems need to be considered for their benefits to society.

The above quotes are a sampling of what leading educators have said regarding education and the energy dilemma. The quotations from post-secondary occupational educators are particularly interesting in as much as these quotes represent almost the totality of what educators in this area have written. That is, there is a surprising lack of concern displayed on the part of occupational educators regarding the relationship of their field to the energy crisis. We also found that post-secondary educators do not, in general, exhibit any great concern for dealing with energy issues. Indeed, mush of the impetus for energy education comes from K-12 educators.

Our own work at FWL has been aimed at developing teacher training models* for energy focused environmental education at the K-12 level that is in keeping with the Enviornmental Education Act. According to the High School Energy/Environmental Education Model, education should be:

---

*Environmental Education Teacher Training Models (EETTM) developed under contract to Office of Environmental Education, 1977-78.

a. holistic and integrated

b. interdisciplinary

c. problem focused and decision oriented involving attitudes and values

Materials and courses currently being developed to find out what was currently being done in this area, particularly at the post secondary level we carried out the following major activities:

- conducted an ERIC search
- contacted leading state and federal officials who are involved in energy education
- reviewed journals relating to the post secondary education
- wrote inquiry letters to state directors of vocational education
- wrote inquiry letters to state directors of adult education
- wrote inquiry letters to leading adult education associations.

We reported the results of this activity in our December letter to you. Among our conclusions were the following.

1. There are a variety of materials and courses being developed for student use. In general, these materials fall in one of the following three areas:

   a. specific training courses in energy technology fields e.g., solar technician.

   b. conservation and home retrofitting skill development.

   c. survey courses of the broad energy area.

2. Although materials are being developed for classroom use, there does not seem to be a corresponding interest in developing materials for teacher use. This condition exists despite the fact the results of a series of regional hearings conducted by the Educational Testing Service to determine the current status and future needs of energy education placed teacher preparation near the top of the priority list.

Primary Energy Sources

Aside from the energy education area, many documents are currently being produced that deal with energy issues and their effects at all levels. In order to develop a comprehensive understanding of the energy area, we have studied many of these documents. Following is a list of some of the major documents we have reviewed.

- Wilson Clark, ENERGY FOR SURVIVAL
- E. F. Schumacher, SMALL IS BEAUTIFUL: ECONOMICS AS IF PEOPLE MATTERED
- Wilson Clark, RENEWABLE ENERGY SOURCES AND A CONSERVATION ECONOMY: A FUTURE SURVEY
- Amory Lovins, THE ROAD NOT TAKEN
- Gil Friend and David Morris, KILOWATT COUNTER
- Odum and Odum ENERGY BASIS FOR MAN AND NATURE
- Scientific American, ENERGY AND POWER
- Ford Foundation, A TIME TO CHOOSE: AMERICA'S ENERGY FUTURE
- Denis Hays, ENERGY: THE CASE FOR CONSERVATION
- Lee Schipper, ENERGY CONSERVATION: ITS NATURE HIDDEN BENEFITS AND HIDDEN BARRIERS
- Herman Kahn, THE NEXT 200 YEARS
- Lane deMoll, RAINBOOK: RESOURCES FOR APPROPRIATE TECHNOLOGY
- Documents from the Energy Research Development Administration - now part of the Department of Energy
- Congressional Record: Reports on Energy Hearings

In addition we have been able to work with Larry Peterson, who has an extensive background in energy and environmental issues and was responsible for designing the EETTM curriculum content models.

Implications For Our Project

Components: The initial image of our curriculum model which we will share with you is based on our synthesis of what educators feel energy education should involve and our judgments concerning the elements involved in understanding the nature of the energy dilemma as it relates to life style and career decision making. We have attempted to develop a model that is holistic and integrated, providing analytical techniques and information oriented toward a conserving approach to energy use.

Users: Our review has led us to several conclusions concerning the relationship of our model development activities and intended user groups. As we have noted, many new materials concerning energy are being produced without a similar emphasis on teacher materials. Because the energy area is relatively new and requires skills and information from a num ber of disciplinary fields, we can assume that many teachers are not familiar with or totally comfortable with energy concepts. As a result, although they may use the materials, they may lack a conceptual framework which would allow them to understand fully what they are doing.

In using these materials and being forced to rely solely on the instructions accompanying the materials, many questions are left unresolved, such as:

1. What kinds of knowlede or experiences does this unit (lesson, chapter, module) require my students to have?
2. How does this unit relate to future units?
3. How do the concepts in this unit relate to other concepts in the curriculum?
4. How does the unit relate to the broader objectives of what I want my students to learn?

Indeed, from observing good teachers in action working in other curriculum areas, we conclude that when teachers have a conceptual framework and a broad

understanding of a curriculum area, they are able to develop and to utilize effectively a wide variety of student materials.

Energy education should not require fancy new sets of materials. The subject matter and building blocks for energy education already exist in the curriculum. What is needed is a conceptual framework or model that is understandable to teachers. This model will allow teachers to develop their own materials designed specifically for their course objectives and their students. Thus, it has become clear to us that our curricular model is aimed at teachers and instructional leaders at the post-secondary level.

Among the potential courses which could be developed using the model:

1. A course which is a component in an instructional leadership sequence in vocational education. Duane M. Neilsen (Bureau of Occupational and Adult Education) has said that among the objectives covered in a leadership development program, are those that will allow a graduate to:

   (a) understand issues in society reflecting on employability and vocational education so that they will be able to relate them to program organization and the tapping of community resources;

   (b) be able to relate contemporary problems and issues in vocational-technical education to broad social and philosophical issues affecting secondary and post secondary education.

   The energy area clearly falls with in these objective.

2. A course which could be a component of a general adult or continuing education program. This course would emphasize an integrated approach to developing an adult's awareness of energy issues and the appropriate utilization of energy conservation techniques.

3. A course in specialized vocational training curriculum related to energy technology. As a prelimary course, this would ensure that participants have a general background and understanding of energy issues as well as having the specialized training skills they would encounter later in their program.

4. A course which would explore in more depth the career and occupational consequences of energy issues. This course might be fit into pre-vocational sequence fulfilling a guidance or career education need.

Conclusion:

This paper has provided background information on our project. During our meeting we would like to:

- review a number of the issues raised in this paper.
- review the elements in the curriculum model. We did not present model in this paper. We will have a draft for our meeting.
- discuss alternative and optimal ways to present the model to teachers.

APPENDIX C:

Materials Produced by Community College
Instructor Working with Project

SAN FRANCISCO COMMUNITY COLLEGE CENTERS

TEACHERS' ENERGY GUIDE

Prepared by George Woodward
Instructor, Pacific Heights Community College Center
San Francisco Community College District
33 Gough Street
San Francisco, California 94103

April, 1978

Materials adapted from the Energy/Environmental Education Projects produced by Far West Laboratory for Educational Research and Development with support from the Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the opinions of the Department of Health, Education, and Welfare or Far West Laboratory and no official endorsement should be inferred.

introduction:

Needed: an overview

Energy topics are vital, and students are interested: they're great in the classroom! Energy topics are confusing, and--when you really get into them--they're depressing: they're awful in the classroom!

However you react to it, energy awareness is certainly growing: everyone is informing us about it; everyone is threatening us about it; it's important and obscure at the same time.

The purpose of this booklet is to reduce the confusion and to increase the understanding of energy in your curriculum. We believe that a brief, lucid tour of the energy terrain is the best way to accomplish this. The terrain is wide, and it can be complicated; but a concise survey will show its main features without sacrificing its realities.

When you decide to teach more than "let's turn our thermostats down," the information you meet about BTUs and biomass can be intimidating. But it doesn't need to be. If you don't get hung up on engineering jargon, you'll find that the whole, broad scope of energy in our lives is very understandable. It's also vital and fascinating. In fact, you already know most of the details. What is generally needed is a sense of the whole, an overview. Hopefully, this guide will give you that.

For this reason, these pages are not "suggested classroom activities." Those are available, and some are listed in the Bibliography. Such activities are useful, but--without an overview--it's difficult to know where they fit into the picture. With a conceptual framework and a broad understanding of the area, you will be able to select meaningful energy materials for your class.

"Energy," as used here, is actually a shorthand for "energy/environmental." Energy is an aspect of environmental developments. It is these developments that are having such basic impact on our lives. Our students, and we ourselves, need skills that can deal with such interconnected developments.

Energy/environmental education

The U.S. Congress recognized this need when it wrote the Environmental Education Act of 1970: "It is the purpose of the Act to encourage the development of new...curricula"...so that "citizens (will) acquire an information and concept base with which to analyze alternative solutions to any environmental... problem."

Environmental education is defined by the law as, "the educational process dealing with man's relationship with his natural and man-made surroundings, and includ(ing) the relation of population, pollution, resource allocation and depletion, conservation, transportation, technology, and urban and rural planning..." A broad educational task!

A Community College has a special problem with such a wide-ranging curriculum. Our students are adults, and few curricular materials have been developed for them. Also, most of our students are in short-term courses and training programs: they are not around for a three or four year curriculum. For them, the field of energy cannot be parcelled out, a little to science, a little to social studies, some to consumer math, etc.--in the hope that they will eventually take all the courses and "get the picture." Our students don't stay around that long.

Our program requires its own approach: our task is to bring an energy curriculum to our students in whatever course or program they are studying. That is, all our courses need a concrete sense of the energy picture. This may seem ambitious, even though the nature of our program requires it, but there is a way for it to happen.

Energy and Decision-making

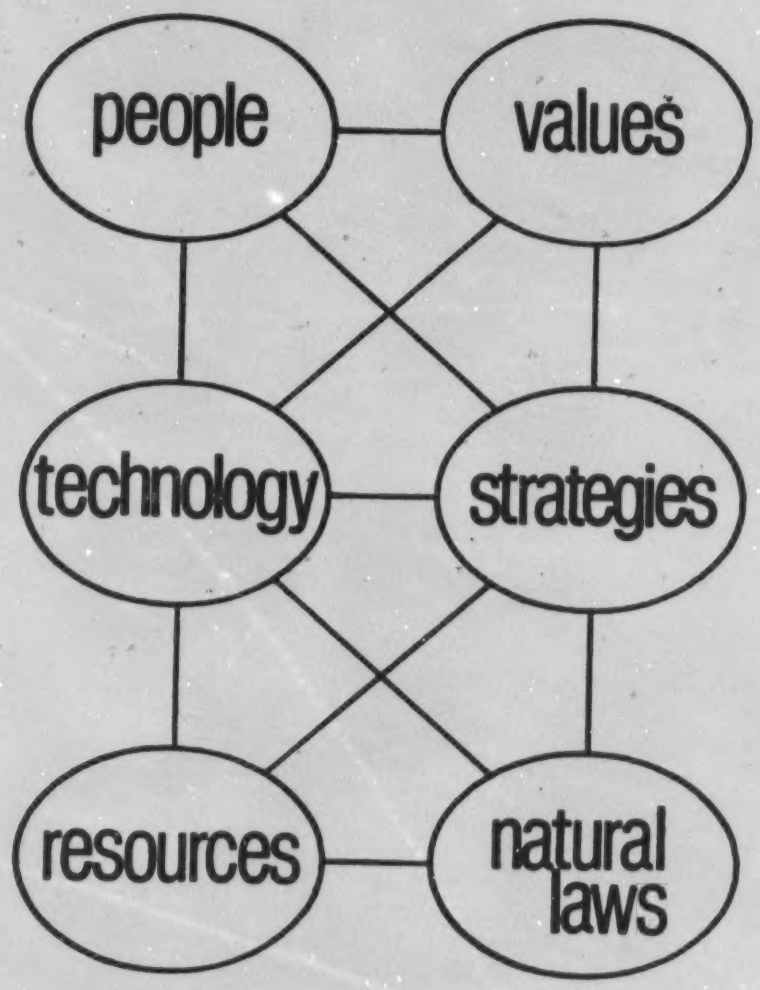
The Environmental Education Act continues: "Traditional learning approaches which normally tend to exclude considerations of mutually reinforcing social, physical, cultural, and policy implications...do not adequately meet the scope of purpose of this act... Stress should be laid on various disciplines working in a highly integrative manner...and to focus on...problem solving as a transferable learning experience." This will enable citizens to "analyze alternative solutions to any environmental...problem in the light of its environmental, social, and economic costs and benefits."

A senior citizen coping with increasing fuel costs; a welding student training to work in a high-energy industry; an ESL student meeting up with American lifestyles: all these students are learning to solve problems. We can't give them answers, for their answers will depend partly on individual values and self-interest. We can give them the context within which they can make decisions, however; and we can help them develop their decision-making skills. The energy terrain is just such a problem-solving context.

The philosophy of the Act is that all persons be given the information they need to develop a broader perception of their own self-interest. It does not sanction an attempt to change the attitudes or values of the population, but rather to provide "models of instruction" that will clarify values, issues, and alternatives.

It is from this direction that an energy curriculum can become part of all our courses. A broad view of the energy terrain will give students the "information and concept base" from which to analyze any environmental problem. From there, they can make decisions that are in their interest. The purpose ofthis booklet is to help develop this holistic approach to energy/environmental questions.

ENERGY MAP



The six parts of this map represent aspects of the energy terrain. They will be investigated in the following pages. Although they could be taken up in any order, we will begin with people.

people:

Jobs

"What will it do to the way I live?..: How will it affect my job?" Those are the questions people ask about the "energy problem." The answers offered depend on the kind of energy-technology to be developed. It's clear that oil and gas are running out, that coal will last a little longer, and that we must change to other energy sources. It's unclear, though, what the new sources and technologies will be. The agencies of government that forecast jobs have made only the most generalized predictions, for the basic energy decisions haven't been made. Solar? Nuclear? Other? What jobs will they generate? How many jobs?

There are at least two views of the job future: one sees energy growth producing jobs; the other sees technological change producing jobs. (These futures are detailed under "Strategies.") In either case, the types and number of jobs developed will depend basically on the scale of the energy-technologies used. Nuclear power (for electricity) requires massive capital investment and a relatively small work force. It is capital-intensive, and employs highly-trained technicians. Hydroelectric power is similar. Solar heating, on the other hand, requires a low capital investment and uses a large work force. It is labor-intensive. Plumbers, sheetmetal workers, heating engineers, small businesspeople make up its work force.

Coal can be developed in either manner: small and local, or massive and centralized. Solar energy could also have capital-intensive development: centralized "solar towers" are being tested to generate electricity. Generally, centralized, capital-intensive industries offer few jobs per dollar invested, and the jobs tend to be those for technicians. (Petroleum and public utilities have more than $100,000 invested per employee.) Local, labor-intensive industries offer more jobs per dollar invested, and the jobs tend to be the skilled and semi-skilled ones familiar in small business and in the building trades. (Wholesale and retail trade and services invest about $10,000 per employee.)

Concern over unemployment would suggest that the more labor-intensive technologies be encouraged. The Ford Foundation Report found that, up to the year 2000, there will be fewer new jobs if we continue our present growth rather than if we have no energy growth. And continuing our present growth, we will consume almost twice as much energy!

With changes coming, the Community College will be called on to help train students for the new jobs. While we are helping them to develop technical skills, it's in their self-interest that we also help them to see how their jobs fit into the energy picture. It's important that they understand how national policy decisions will affect their jobs and their futures. These should be a part of every occupational and vocational course.

Energy policy

Present government policy favors centralized, capital-intensive technology. For example, nuclear power development receives 80% of the current U. S. energy budget, while solar energy receives only 3%--and that is directed to capital-intensive studies. Federal plans focus on electricity--the most expensive

and highly centralized form of energy--or on coal-based synthetic fuels. The Department of the Interior, the Atomic Energy Commission, and the Federal Power Commission, coordinated by the Department of Energy, are responsible for resource utilization. They tend to reflect the viewpoint of the primary energy industries.

In the private sector of the economy, faith in centralized, capital-intensive growth is strongest among the large corporations. Oil companies, for example, have become "energy companies" by expanding into the uranium industry. Since the job of corporate managers is the planning of growth, they naturally want it to continue.

Energy consumption

For most of us, our jobs determine our incomes, which determine how we live and how we satisfy our human needs. Needs, such as shelter, food, recreation, protection and curiosity, can be satisfied in many ways. Satisfaction does not mean the same thing to everyone: not the same goods and services, not the same degree of energy-use.

It's often said that our happiness depends on our using a lot of energy. This is based on the assumption that happiness depends on a nigh Gross National Product (GNP, total goods and services), which in turn is said to depend on a high energy-use. These assumptions lump together several ideas, however. First, "energy-use" is measured by the fuel taken from the ground; that does not tell us how much of it gets to where it is needed. Second, after it gets there, the efficiency of its end-use may be high, or much may be wasted. Third, it may be used for something worth doing, for something trivial, or for something harmful. Between 1945 and 1970, the U. S. GNP roughly doubled. Are we roughly twice as happy?

Energy consumption depends on a person's income. Use increases with income. Also, the form of use changes. Low-income people use two-thirds of their energy directly--for gas to heat the house, for example. High-income people use two-thirds of their energy indirectly--for manufactured goods made by energy, for homes that required energy for building, for example. As we develop energy-conserving policies, we must remain aware of its impact on different income levels. Reducing direct energy use will affect different people than will the reduction of indirect energy use.

Health and environmental control

While energy consumption helps satisfy our needs, it also produces hazards to our health. The causes of environmental pollution are detailed under "Resources." Its effects can be poor health and even death. While our students are receiving technical training, they need to know the effects of their future job and workplace on their health, and their impact on the environment.

Air and water quality has improved under government environmental control. But the control has had two weaknesses: first, electric utilities, oil companies and automobile manufacturers have dominated pollution control legislation; second, energy-intensive materials, fuels, and procedures have been relied on to monitor pollution. These factors show that priorities are not yet clear.

values:

Values and Conflict

Our political activities, our schools, the way we make and distribute goods, would seem strange behavior to anyone born, say, before 1700. The values underlying our behavior would be just as strange. Our belief that "new" is usually "better", for example. It seems quite natural to us that people work in factories and offices, not at home; that they work with machines, not with their hands. But our attitude would have astonished medieval Frenchmen; as, in turn, their Christian view of nature and of their place in it would have amazed Cleopatra.

How people see the world and themselves in it--their worldview--has changed with time. People born after World War II see the world differently from people born before World War I. Modern life is characterized by such changing perspectives. Since people are often threatened by change, conflict usually accompanies it.

Daily, we are becoming more aware of our impact on the environment and its return effect on us. Conflict has arisen between this new consciousness and older attitudes--conflicts within people and between them.

Decisions

These conflicts lie behind many "discussions" of future energy strategies. Behind the talk are unspoken gut-level feelings, like fear of what is to come. These feelings will affect people's decisions. They need to be articulated, so that they can become a conscious part of decision-making.

When people buy a car, are they buying transportation?... or status? Is he buying "masculinity?" Is she buying "freedom?" A classroom discussion of modes of transporation should include an articulation of the "mystique" surrounding them.

Our job as teachers is not to judge our students' values, but to help them clarify their values. By being clear about the things they value, they are better able to make decisions in their own self-interest. In the field of energy, there are many decisions ahead.

Example: Two Worldviews

Two examples of the values and assumptions contained within worldviews are given here. They represent two common views of energy utilization. Necessarily simplified and condensed, they may be read as internal monologues or as public statements.

Worldview A

We must continue our material growth. That means energy growth--more industries and more consumption.

(Our past growth has been based on a fossil fuel "bonus" that is now running out. But another bonus will be found. Radioactive materials seem the best choice; if they become scarce, the fast-breeder reactor will extend them. When radioactive minerals are exhausted, another bonus will be found. We may succeed in developing a deuterium-fusion technology. Or whole sections of the desert, or orbiting satellites, can become solar collectors.)

Nature must "give way" to our growth. We can "use up" nature or even bulldoze it under, for man rules over nature. Our economic growth comes first. Man is the only rational creature on this globe. The standard of living we now have comes from the technology developed by that rationalism. There's nothing wrong with a man-made world; and there will always be plenty of nature left to enjoy. Most of the environmental damage caused by technology can be repaired by technology.

Pollution comes with growth. Since the whole country benefits from growth, the whole country should pay to clean up the pollution. This should be done through taxes; it's the government's responsibility. Large-scale technology is our strength. Only energy-intensive industries are efficient enough to produce the goods needed to overcome poverty in this world. If environmentalists stop energy growth, poor people will be stuck at their present standard of living. There won't be enough goods to go around. In the competition between nations, if we don't grow, we'll just "go under."

Worldview B

We must have material sufficiency. We can achieve it without increasing our energy use. We can use earth's resources only as fast as they are being renewed, for they are limited. Earth is finite. We have some technologies, and we can develop more, which allow us to live in equilibrium with the rest of nature. We don't need another (temporary) bonus. Those already suggested are very expensive and dangerous. The environment can handle only a limited dose of pollution. A really big "bonus" of energy, consumed by industry and passed on to the environment as heat and waste, could destroy it and us. We are part of nature. New technologies must safeguard its health. Both our rational skills and our intuitive side will be needed. We have the opportunity now to nurture, to protect and to use the earth kindly. These are very satisfying activities. They are also in our own self-interest, for our survival depends on the survival of earth's natural systems. Because resources are finite, those who use them should pay for them. Factories that use water to receive their wastes, for example, should pay the cost of renewing the water. There is a larger equity involved also: The poor in this country and in other nations are not being reached by centralized, energy-intensive industries. But, with the new technologies--modest in capital, local, human in scale--people can begin to produce their own goods, services, and energy.

Equal access to the means of production, to the education required, to the political means to make it effective--that is equity.

With the many adjustments ahead, cooperation with one another, just as cooperation with nature, will be essential for our survival.

natural laws:

Ecosystems

Earth's radius is 4,000 miles. Its outer skin, about 9 miles thick, contains all living things. Everything necessary for life is there: solar energy, air, water, soil, heat, wind, and essential chemicals. This thin envelope of living things is the biosphere.

Energy runs this life-system, and ecosystems are its working parts. An ecosystem is an environment with its groups of living organisms. Soil is an example: it is an ecosystem of many plants and animals, organic debris, nutrients, minerals, water and gases. Its living and nonliving parts exchange energy and materials in a complex "flow" that links them all together. Other such systems are at work in oceans, lakes, streams, and in the atmosphere. They all run on flows of energy derived from the sun.

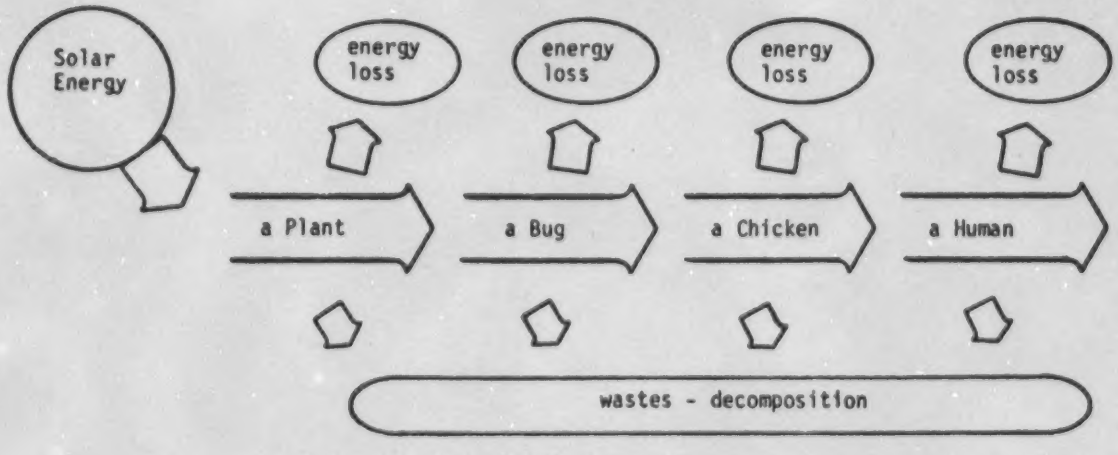
Energy enters an ecosystem; it is used to do work there; and it leaves the system. There is an input; the parts of the system interact; and there is an output. The total interaction within the system--its total life--depends on the total energy available to it. How an ecosystem uses its budgeted energy decides its success or failure. The system that gets the most energy, and uses it most effectively, survives.

Through the slow, careful centuries of earth's history, surviving ecosystems have evolved an amazing diversity of organisms and environments linked by beautifully intricate patterns of energy flow.

Energy Flow in Natural Systems

Under normal conditions on earth, energy cannot be created or destroyed. However, it can be converted from one form to another, and it can be transfered from one place to another. Thus it can flow through ecosystems.

One type of energy flow is the food chain. In this case, energy comes from the sun; it is passed from organism to organism as food; each organism uses some energy for its own maintenance; and eventually the energy leaves the system.



Energy losses in the food chain are great, especially that energy used by each organism for its own maintenance. The food that each organism consumes contains energy of high quality--that is, it can do many kinds of work, it is flexible. Used by organisms to do work, this energy is downgraded to heat energy of low quality. That is, it is too dispersed to do any work. The heat energy enters the environment and diffuses into space, leaving the earth. Thus, during any transfer of energy, some energy is degraded to low-quality heat energy.

The only organism in the food chain that does not receive high-quality energy is the plant. Sunlight is low-quality, diffused energy. Plants concentrate that energy into a high-quality form and store it in the organic molecules of food. This is photosynthesis: basically a way to concentrate solar energy, much as a magnifying glass focuses solar energy to burn a hole in paper. Animals "burn" the food energy, which degrades it to low-quality heat and it is lost from the food chain.

The organic wastes from this chain are not lost, however. Soil organisms decompose wastes into simpler compounds. Nutrient elements such as nitrogen, phosphorus and sulfur are released into the environment. They are necessary for life, yet limited in amount so other organisms recycle them. Some organic materials are stored as sediments in the earth. These can become fossil fuels, over a long period of time.

Dynamic Equilibrium

Each ecosystem has evolved to operate with a definite flow of energy and nutrients. Disturbing this flow stresses the system. A healthy system responds with compensating mechanisms that work to bring the system back to normal.

An example would be our constant body temperature. If the external temperature rises, our body is warmed and responds by producing less heat and sweating to lose heat. Our temperature returns to normal. There is stress and response--change and return to normal. It is a dynamic equilibrium.

Some response increases change. When external temperatures rise too high, our body regulation breaks down: the body responds to the heat by producing more heat, which makes it produce yet more heat, etc. It moves farther and farther from normal. This vicious cycle results in death.

In ecosystems, change can "snowball" in the same way. When restraints on population (disease, starvation) are reduced, there is greater production of offspring, who produce more, who produce more, etc. Nonregulated growth of this type can cause the system to fail.

Ecosystems have evolved with incredible slowness to achieve finely-tuned methods of self-regulation. When we interact with them, we must respect their delicate mechanisms. We need knowledge of their workings before we act to change them.

resources:

Earth's energy resources are of two types: renewable and nonrenewable. Renewable resources--such as solar energy--are constantly flowing through earth's ecosystems. Nonrenewable resources--such as fossil fuels--are exhaustable. Fossil fuels, produced by the burial of plant and animal material, are renewable at a geologically slow rate. Our present supply accumulated over a period of 600,000,000 years. We are using it up in a few hundred.

Brief descriptions of earth's primary energy resources follow .

Nonrenewable Resources

Fossil Fuels: produced as described above, they account for 96% of U.S. usage.

Natural Gas is a mixture of hydrogen, methane, propane, and butane. Petroleum is a mixture of hydrocarbons. Coal is about 80% carbon; it releases more than twice the energy of an equivalent weight of wood; it burns "dirty." Oil Shale is oil in rock; it contains about as much energy as is needed to bring it to market (no net energy is gained). Tar sands are oil in sand, strip mined or deep mined.

A major problem of fossil fuels is the air pollution they cause, mostly through cars and power plants. They have a short-term effect on air quality and a long-term effect on climate (heating) They affect health, interfere with photosynthesis and damage property (U. S. estimate for 1968 was $16 billion). They also produce thermal pollution: one estimate is that by the year 2000, US power plants' excess heat would raise the temperature of our runoff waters by 20 degrees! Fossil fuels also cause environmental degradation from strip mining, pipeline breaks, oil spills, heat loss from pipelines, etc.

Nuclear Energy is obtained from radioactive minerals: Uranium, the most common, accounts for 1% of present U.S. usage. The energy is given off during fission (splitting) of unstable atoms. This resource was once seen as the world's energy future, but now it's regarded as potentially the most hazardous of all sources. Its advantage is that it produces no air pollution. Disadvantages include leaks of radioactive material at plant site, in transit, or at storage site (irradiation of humans can cause burns, illness, death). A nuclear accident could contaminate an area for hundreds of thousands of years. It causes thermal pollution. Nuclear plant wastes can be used by terrorists, and security would add dollar costs and social costs. Nuclear energy is tied in with proliferation of military weapons. Presently, there is no way to dispose of the plant itself after its expected "life" of 30 years.

Nuclear fusion would use the sun's process of combining hydrogen atoms (the heavy variety called deuterium) to yield a clean energy. Major environmental effect would be thermal pollution. Like fission-energy, fusion would require centralized, energy-intensive plants. The technology is not presently developed to withstand the 180,000,000 degree temperature of the fusion reaction.

Renewable Resources

Solar Energy is produced in the sun by fusion of hydrogen nuclei. A small fraction of the sun's light and heat reaches the earth (theoretically, solar energy could be collected out in space). It is abundant, and it has a light environmental impact. Good for heating and cooling buildings, though it is difficult to store on a large scale. Solar towers and solar farms could generate electricity in arid regions, but they are centralized and capital-intensive. Solar cells (photovoltaic electricity generation) require that much energy be used in their manufacture. Solar energy is converted into the following forms:

Wind is produced by unequal heating of the earth's surface; an intermittant resource available at a limited number of good sites.

Waves are produced by wind. Studies are being made to harness wave energy off Ireland.

Ocean Currents and Ocean Temperature Differences (shallow to deep water)--The transmission of power from ocean to land is difficult.

The Water Cycle--precipitation and runoff produces hydroelectric power, about 4% of present U.S. usage. It must be sited wisely. It may cause loss of valuable delta land (e.g., Aswan Dam). It is clean power with no storage problems. It provides flood control and irrigation. Available rivers are limited.

Photosynthesis produces wood and other energy crops (sugar cane, sunflowers, algae, seaweed); called biomass. Deforestation is presently a problem.

Agricultural, forest, and municipal wastes--if not recycled can be burned or converted to fuel.

Solar energy forms add no pollution, even thermal. They add no overall heat because they use only the earth's normal supply of energy coming from the sun.

Tidal Energy: The twice daily rise and fall of sealevel is caused by the moon's gravitational pull--only a few areas of the earth have useable tides.

Geothermal Energy is hot water and steam reaching the surface of the earth from its hot interior. Although not completely renewable, it is very long-lived. Only a few areas have proper underground conditions, and waste mineral-water disposal, gases, and heat are problems. The Geysers in Northern California could generate enough electricity for one-half the needs of the Bay Area.

The fact that the earth has these resources does not mean that they are available to us. They become available when technology can apply human energy and capital to their utilization. Oil reserves are measured--not by the oil in the ground--but by the oil we can draw from the ground. In practice, this means that a resource is available when people are willing to invest capital in its utilization. Solar energy is becoming available for heating buildings as people are beginning to invest capital for solar research, development, production, and installation.

This table shows the costs of utilizing some of earth's resources: (from Lovins: Soft Energy Paths: Toward a Durable Peace)

ENERGY SYSTEM	FORM	$ COST FOR EQUIVALENT TO ONE BARREL OF OIL A DAY
Traditional, direct fossil fuel (today)	fuel	2000 - 3000
North Sea oil (late '70s)	fuel	10,000
Frontier oil and gas ('80s)	fuel	10,000 - 25,000
Conventional, central coal to electric ('80s)	electric	170,000
Nuclear to electric ('80s)	electric	200,000 to 300,000
Fluidized bed coal to heat (early '80s)	heat	30,000 (includes heating system)
Solar retrofit with present expensive technology	heat	50,000 - 70,000 (")
Agricultural and lumber wastes to alcohol ('80)	fuel	13,000 - 20,000
Municipal wastes ('70s)	fuel	30,000
Wind to electric (late '70s)	electric	200,000

SS

technology :

Net Energy

Technology is how we get useful energy from natural resources. Applied science, tools, a knowledge-base make up technology. It can seem very complex today. An outline showing how resources are used may simplify the picture: (from "High School Energy/Environmental Education Teacher Training Model" - see Bibliography)

STAGE OF UTILIZATION	NON-RENEWABLE	RENEWABLE
	e.g. OIL TO ELECTRICITY	e.g. WHEAT TO BREAD
EXPLORATION: Finding resource deposits, basic research and development of exploratory techniques, machinery	Geologic exploration for oil	Agricultural chemists' search for improved method of wheat production
EXTRACTION: Removing the resource, machinery and site equipment, materials, operating agencies, maintenance over the life of the site	Tapping oil well	Harvesting wheat
TRANSPORT I: Transportation mechanisms and operating energy necessary to carry the resource to the next facility	Shipment of crude oil	Trucking of grain
PROCESSING: Energy to run machinery, construction of the facility, its maintenance and operating energies	Processing of crude	Grinding of grain
TRANSPORT II: Transportation systems and the operating energies required to move the resource to the conversion plant	Shipment of partially refined oil to a regional refinery	Trucking of flour to baker
CONVERSION: Plant construction, materials and maintenance	Transformation of oil into electricity	Transformation of dough into bread
DISTRIBUTION: Energy costs, equipment, storage facilities and networks to move the converted product from final facility to point of consumption	Sale of electricity to a household	Sale of bread at grocery store
END USE: Input to the system of human needs	Operate electric toaster	Eat the bread

Before the first stage of utilization, we can think of the resource in the ground as having a gross energy content. Each stage that makes the energy available requires the payment of energy costs. For example, natural laws require that some energy be lost, as low-level heat, during each transfer or conversion. There is also loss from improper storage, spoilage, spillage, contamination. The capital to finance each stage represents energy, as does the time during which the capital must be invested (lead-time) before delivery.

When all energy costs are substracted from the gross energy, we know the net energy available from the whole utilization process. This net energy analysis is our basis for decisions on the appropriate use of resources.

Some forms (e.g., solar, oil shale) are too dilute to be used for all kinds of work. Energy must be used in upgrading them to greater flexibility. Thus, their net energy is low. Yet, some sources are too concentrated and require the expenditure of energy to make them usable. Nuclear reactors produce such tremendous temperatures that significant costs are involved in controlling them.

The net energy yields of oil, coal and natural gas have been decreasing rapidly as the easily available sources are being used up. Offshore drilling rigs, for example, are very expensive because they contain enormous amounts of steel, which takes much energy to make and form. The salt water causes corrosion, storms cause a great deal of damage, and large amounts of oil must be left in the ground because of difficulties of operating underwater.

An important cost in resource utilization is the cost of using the environment. Clean air and clean water are used while utilizing other resources. As they become more scarce, they become more expensive. Those who use air and water should pay for them, just as a steelmaker must pay for iron.

Since air and water can be recycled, users need only pay the cost of cleaning them. These environmental costs must be added to the other costs of utilizing a resource when we calculate that resource's net energy.

The effects on workers' health, and on the health of the general population, are also a cost of using a resource. It will be paid by those whose health is undermined, by government (taxes) or by those who use the resource. Whoever pays, health costs must be included in calculating net energy.

In the past, environmental costs and health costs have been ignored in the costs of a resource. For this reason, fossil fuels have been an exceptional bonus. They have seemed cheap, because the costs to the environment and to health have been hidden--they have been diffused through society. But they have been a real cost of using fossil fuels.

We are entering an era when resource usage will be critical for our survival. All real costs of using a resource must be considered. We must gain positive net energy from a resource. Otherwise, to use it is a waste of energy and a threat to our survival.

For this reason, future technologies will be much more expensive. Or they'll seem so, because we'll know what they really cost. Because our capital is limited, we can't invest in all technologies, just to see which one will work. We must invest in those that will give us maximum net energy, for they will determine how many of us the earth will support.

Actually, we will need a mix of technologies, for there is a mix of end-use jobs to be done. We will need to run factories, melt iron, heat homes: each of these end-uses requires a certain energy quality.

Energy quality

Solar, electrical, nuclear and other energy forms vary in their energy quality. Electrical energy, for example, is a high-quality energy because a lot of work has gone into it to upgrade it, to make it flexible. Four calories of fossil fuel energy is burned to produce one calorie of electrical energy.

Electricity's high-quality energy is wasted on low-quality work, such as heating a room. That can be handled by a low-quality form like solar energy. Sharpening pencils and carving meat are better done by human energy, than by expensive electrical energy. Electricity should be used to turn motors, to give light, etc. To conserve energy, we must fit energy quality to the end-use, to the job to be done.

strategies:

Energy Past

Historically, new technologies have enabled people to gain more energy from the environment, and to use it more efficiently. Humans discovered fire, the labor of animals, the technology of tools and weapons, weaving, ceramics, painted images, agriculture, windmills, water power, steam, fossil fuels, industrial technologies. All these with the goal of satisfying human needs. And we humans have succeeded to an amazing degree.

In fact, we have been too successful. Our present environmental problems grow with our successes. We have solved technical problems so well and so rapidly that we are distorting and dangerously stressing our ecosystem. One aspect of our unregulated full-speed-ahead growth is the energy crisis.

We have met an iceberg. Its visible tip is expensive gasoline, but its hidden structure is our transportation system the mobility, convenience, jobs and investments it offers, and the pollution, fuel consumption, accidents and vehicles it requires. To blame the oil companies is to oversimplify. Their job has been to exploit oil resources, and they have done that very well. Our job is to know what we want in a transportation system, and to begin making the decisions that will get us there.

The history of how we got to this iceberg is part of any school's energy curriculum. We need a broad historical perspective on energy technologies and past energy decisions. Future technologies require sound decisions now. Options have been pointed out by various individuals, groups and interests. We will examine these possible futures, as presented in Ford Foundation Study, A Time to Choose.

Energy Future

HISTORICAL GROWTH	TECHNICAL FIX	ZERO ENERGY GROWTH
Assumes that energy use in the United States would continue to grow till the end of the century. It assumes that no deliberate effort would be made to alter our habitual patterns of energy use. Instead, we assume that a vigorous national effort would be directed toward enlarging energy supply to keep up with rising demand.	Reflects a conscious national effort to use energy more efficiently through engineering know-how--that is, by putting to use the practical, economic, energy-saving technology that is either available now or soon will be. The effect on the way people live and work would be quite moderate.	Would not require austerity, nor would it preclude economic growth. It includes all the energy-saving devices of Technical Fix, plus extra emphasis on efficiency. Its main difference lies in a small but distinct redirection of economic growth, away from energy-intensive industries toward economic activities that require less energy. Compared with the other energy futures, a ZEG future would have less emphasis on making things and more on offering services.
It is possible, but it would not be easy to fuel the Historical Growth rate. It would mean aggressive development of all available energy sources--oil and gas onshore and offshore, coal, shale, nuclear power. There would be little scope to pick and choose among sources of supply. Coal and nuclear power would have to be the mainstays of energy supply by the year 2000.	Supply options are more flexible in this scenario. The slower growth in energy consumption permits more flexibility and a more relaxed pace of development. The nation could halt growth in at least one of the major domestic sources of energy and still demand less from the other supply sources than Historical Growth requires.	ZEG would allow still more choice in supply from conventional sources. After 1985 this scenario could also permit use of cleaner, renewable, but smaller scale energy sources such as windpower, roof-top solar power, and recycled waste to meet a larger share of the total energy demand. Still, it should be remembered that even in this scenario the national energy appetite would be very large.

These three scenarios agree that fossil fuel resources will not meet future energy requirements and that alternative strategies must be developed. The Historical Growth scenario advocates continuing present energy practices into the future. It places energy decisions in the marketplace, to be made by the groups that produce energy. This means that important energy decisions will be out of most people's hands.

Conservation

Both Technical Fix and Zero Energy Growth require energy conservation. This does not mean deprivation, nor reduction in quality of lifestyle. It means consuming less of those products that are not energy-efficient, that pollute, that are nonessential luxuries. We are responsible for deciding our energy future.

Plugging leaks and using thriftier technologies defines the Technical Fix scenario. It would use today's technologies, when economical. The goods and services produced by our system would continue to be as useful, or as useless, as they are at present.

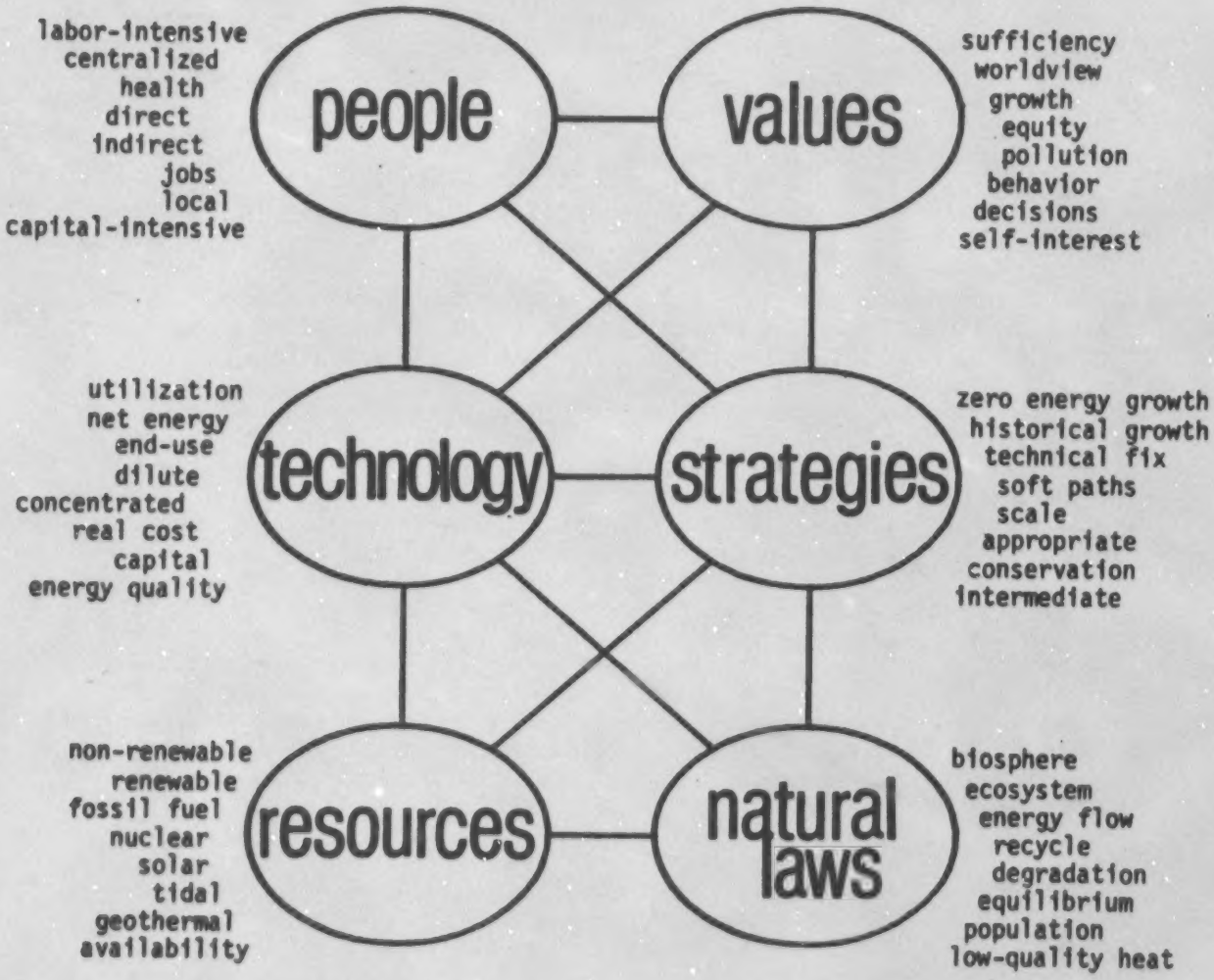
An energy study for Seattle convinced that city not to buy into Oregon's nuclear power plants. The study showed that with appropriate energy efficiency measures (fixes), no new electricity generating capacity would be required for Seattle through 1990.

Accelerating growth over the past 100 years has meant rapid consumption of cheap fossil fuels. They will be very scarce in 25-50 years. Zero Energy Growth believes we must stabilize our energy usage and shift to renewable sources.

Appropriate technology uses processes small in scale, controllable, and saving of resources. Intermediate technology is "technology with a human face": reducing the scale of our massive technologies to make communities self-reliant in their production of energy. Voluntary simplicity is a frugal lifestyle, in human-scaled living and working environments. It allows us a richer life and a fuller development of our human potential. All emphasize a shift from large scale, centralized technology to small scale, human technology, from quantity to quality, from powerful, capital-intensive tools to skillful, available tools, from material resources to human resources.

Soft Energy Paths provide ways to reach these goals. "Soft" technologies use renewable energy sources to match energy scale and energy quality to end-use need. For example, electricity is high-quality energy; it is wasted if its end-use is to heat a room (a low-quality job). Large scale, centralized power stations do most jobs less efficiently than do local power producers. Soft paths require removal of institutional barriers to energy conservation, technical fixes, rapid development of renewable energy sources, and special transitional fossil fuel technologies. The latter will serve as our "bridge" to truly soft technologies. We must act now, while some fossil fuel reserves remain to serve as such a "bridge."

ENERGY MAP


labor-intensive
centralized
health
direct
indirect
jobs
local
capital-intensive
people
values
sufficiency
worldview
growth
equity
pollution
behavior
decisions
self-interest
utilization
net energy
end-use
dilute
concentrated
real cost
capital
energy quality
technology
strategies
zero energy growth
historical growth
technical fix
soft paths
scale
appropriate
conservation
intermediate
non-renewable
renewable
fossil fuel
nuclear
solar
tidal
geothermal
availability
resources
natural laws
biosphere
ecosystem
energy flow
recycle
degradation
equilibrium
population
low-quality heat

to sum up:

Many people "turn off" to energy problems. Maybe they do this because energy/environmental questions seem to have no boundaries. (You start talking about frost-free refrigerators and soon you're discussing U.S.-Arab-Israeli relations!) The map outlined in this booklet, describes the main features of the energy landscape, without needing to fix boundaries. It is a view from a distance. The structure it presents can focus our discussions and make our decisions more viable.

The map is one part of an energy curriculum. It describes the content of the curriculum; that is, what we need to know. It does not include teaching skills and management questions. The materials needed, the learning arrangements, the support structures, the guidelines for assessing progress--the nitty-gritty of teaching--have not been discussed. We believe that teachers can develop and utilize a wide variety of materials and situations, when they have a conceptual framework and a broad understanding of the curriculum area. The latter has been the goal of this booklet.

Finally, there is another part of the energy curriculum: our attitudes. Our appreciation of energy/environmental relations and of the whole, wide scope of energy effects will not be lost on our students. Our words and actions are part of what has been called the "hidden curriculum." Our values and lifestyles, and even the school's use of light and heat, enter the curriculum, because they're part of the learning situation.

If we want to encourage active participation in energy-environmental decision-making, we must provide course structures and classroom situations that encourage it. We realize that some human behavior patterns are damaging the natural systems we depend on. They are leading us to a crisis situation. The energy curriculum we employ must allow room for these behavior patterns to change. In this way, they can be reintegrated into a healthier relation between humans and their environment. We must provide the space for that change.

At the beginning of this booklet, we quoted Ernest L. Boyer's (U.S. Commissioner of Education) remarks. They sum up the purpose of this energy curriculum, and they express what we as teachers can specifically work for: the conservation of the school's energy resources; the training of people with technical know-how; and the development of the knowledge and values needed for our global survival.

bibliography :

GENERAL: "High School Energy/Environmental Education Teacher Training Model," Far West Laboratory for Educational Research and Development, 1978.

PEOPLE: Grossman & Daneker: Guide to Jobs and Energy; Washington, D.C.: Environmentalists for Full Employment, 1977.

Hannon: Energy Conservation and the Consumer; Science, Vol. 189, July, 1975.

VALUES: Clark: Energy for Survival; Garden City, New York: Anchor Press/ Doubleday, 1974.

A Time to Choose--America's Energy Future; Energy Project of the Ford Foundation; Cambridge, Mass.: Ballinger, 1974.

NATURAL LAWS: Odum & Odum: Energy Basis for Man and Nature; New York: McGraw-Hill, 1976.

Sutton & Harmon: Ecology: Selected Concepts; New York: Wiley, 1973.

RESOURCES: Transition, A Book on Future Energy: Nuclear or Solar, A Report to the Oregon Energy Council Prepared by the Office of Energy Research and Planning, January 1, 1975, Prometheus Unbound, Specialty Books, Portland, Oregon, 1977.

Fowler: Energy-Environment Source Book; Volume II, Energy, Its Extraction, Conversion and Use; Washington, D. C.: National Science Teachers Association, 1974.

TECHNOLOGIES: South Florida: Seeking a Balance of Man and Nature; South Florida Study, Florida Department of Administration, 1974.

Miller: Living in the Environment; Concepts, Problems, and Alternatives; Belmont, CA: Wadsworth Publishing Co., 1975.

STRATEGIES: Schumacher: Small is Beautiful: Economics as if People Mattered; New York: Harper & Row, 1975.

Lovins: Soft Energy Paths: Toward a Durable Peace; Cambridge, Mass.: Ballinger, 1977.

For classroom use

Award Winning Energy Education Activities; Ed. Helen Carey, National Science Teachers Association, 1977.

Energy and Conservation Education: Activities for the Classroom: (Lesson plans, grades 7-9; Lesson plans, grades 10-12); Portland, OR: Energy and Man's Environment, 1977.

Terry & Witt: Energy and Order; San Francisco, CA: Friends of the Earth, 1976.

Smith, Crocker, & DeRose: Energy-Environment Mini-Unit Guide; Washington, D.C.: National Science Teachers Association, 1974.

Ideas and Activities for Teaching Energy Conservation, Grades 7-12; Knoxville, Tenn.: University of Tennessee, 1977.

Interdisciplinary Student/Teacher Materials on Energy, the Environment, and the Economy; (a series of modules) National Science Teachers Association, 1976.

Values in Conflict: Interdisciplinary Environmental Education Unit; Fort Myers, FL: Lee County Environmental Education Program.

thanks

to Juliette Van for typing this booklet

and

to the Printing Class,
Mission Community College Center,
Juanita Owens, Instructor

APPENDIX D:

Project Information Letter

ENERGY CONSERVATION CURRICULUM MODEL PROJECT

In 1977, Far West Laboratory for Educational Research and Development received a grant from the United States Office of Education's Bureau of Occupational and Adult Education to develop a curriculum model for environmental quality and energy conservation. The model was intended for use at the post-secondary adult and vocational educational level.

In pursuing the project, the staff focused on energy conservation for several reasons. First of all, energy is today clearly a national priority. Further, energy production and utilization technologies contribute greatly to our current environmental crisis; thus our need to conserve energy presents us with an opportunity to also preserve environmental quality. Finally, staff brought to the project the perspective that successful implementation of energy conservation requires citizens who are capable of decision making regarding not only how much energy is being used, but also how wisely this energy use promotes both environmental quality and the equitable satisfaction of human needs. Developing the energy literacy of students so that they can make these decisions should be of concern to all areas of adult and vocational education.

The Model is focused at the educational practitioners in order to provide them with a conceptual framework for a comprehensive understanding of energy conservation. The Model is composed of a series of four documents:

1. An Orientation Guide provides a rationale for the broader meaning of energy conservation and its relationship to adult and vocational education and describes the use of the remaining documents.

2. A Curriculum Content Model outlines the conceptual framework for understanding energy conservation and its knowledge components.

3. A Resource Book elaborates on the knowledge components of the Content Model and contains an extensive bibliography of references and information resources.

4. An Application Guide provides guidelines and examples of how the curriculum content could be integrated into existing courses or used as a basis for new course development.

At the present time, dissemination of these Model documents is beyond the scope of the project. They will, however, be submitted to ERIC. Forthcoming issues of Resources in Education should be checked for information about their availability through the ERIC system.

Energy Conservation Curriculum Model Project Staff

Jacqueline Haveman, Principal Investigator
Kathryn O'Connell, Project Coordinator

This activity was supported, in whole or in part, by the United States Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the United States Office of Education, the Department of Health, Education, and Welfare, or the Far West Laboratory for Educational Research and Development, and no official endorsement by these agencies should be inferred.

FAR WEST LABORATORY FOR EDUCATIONAL RESEARCH AND DEVELOPMENT
1855 FOLSOM STREET · SAN FRANCISCO, CALIFORNIA 94103 · (415) 565-3000

APPENDIX E:

Project Workshop Materials

CALIFORNIA INDUSTRIAL EDUCATION ASSOCIATION

1979 CONFERENCE

GOLDEN YEARS IN INDUSTRIAL EDUCATION

RED LION MOTOR INN **MARCH 9 & 10, 1979**

21. **INTEGRATING ENERGY CONSERVATION CONCEPTS INTO THE OCCUPATIONAL EDUCATION CURRICULUM**

The purpose of this workshop is to introduce educators to basic concepts relevant to exploring the issue of energy conservation and to begin to explore ways in which energy conservation concepts can be integrated into vocational instructional programs.

Speakers: **Ms. Jacqueline Haveman and Ms. Kathryn O'Connell**
Far West Laboratories, San Francisco

ENERGY CONSERVATION RESOURCE BIBLIOGRAPHY

Prepared by

ENVIRONMENTAL QUALITY AND ENERGY CONSERVATION
CURRICULUM MODEL PROJECT*
Far West Laboratory
for Educational Research and Development
1855 Folsom Street
San Francisco, California 94103

I. PRINTED MATERIALS

A. Reference Works. The following books contain elaborations of many of the concepts included in the Energy Conservation Curriculum Model.

Adelson, Philip H., ed. Energy Use: Conservation and Supply. Washington, D.C.: Association for the Advancement of Science, 1974.

Compilation of articles on energy supply and alternative systems.

Clark, Wilson. Energy for Survival. Garden City, New York: Anchor Books, 1974.

A valuable discussion of the impacts of energy technology on the environment.

Commoner, Barry. The Poverty of Power: Energy and Economic Crises. New York: Knopf, 1976.

Elaborate discussion of some of the economic issues.

Cornish, Edward. The Study of the Future: An Introduction to the Art and Science of Understanding and Sharing Tomorrow's World. Washington, D.C.: World Future Society, 1972.

Readable introduction to the study of the future - excellent bibliography.

Foin, Theodore C., Jr. Ecological Systems and the Environment. Boston: Houghton Mifflin Company, 1976.

Presents a unified framework for environmental analysis.

Ford Foundation. A Time to Choose: America's Energy Future. New York: Ballenger, 1974.

A classic volume - focuses on the energy future.

Fowler, John. Energy-Environment Sourcebook: Volume I & II. Washington, D.C.: National Science Teachers Association, 1975.

A wealth of energy information and data.

*This project is sponsored by a grant from the United States Office of Education's Bureau of Occupational and Adult Education.

Lovins, Amory. Soft Energy Paths: Toward A More Durable Peace. San Francisco: Friends of the Earth, 1977.

Presents the concepts of "hard" and "soft" energy paths.

Merrill, Richard and Gage, Thomas, eds. Energy Primer: Solar, Water, Wind, and Biofuels. New York: Delta Books, 1978.

A review and compilation of resources for small scale energy systems.

Nash, Hugh, ed. Progress As If Survival Mattered: A Handbook for a Conserver Society. San Francisco: Friends of the Earth, 1977.

Application of conservation conscience to many fields of activity.

Odum, Howard and Odum, Elizabeth. Energy Basis for Man and Nature. New York: McGraw Hill, 1976.

Discussion of net energy systems and energy diagramming.

Schumacher, E.F. Small is Beautiful: Economics as if People Mattered. New York: Harper and Row, 1973.

Contains the theory and practice of intermediate technology.

Steinhart, Carol E. and Steinhart, John. Energy: Sources, Uses and Role in Human Affairs. North Scituate, Mass.: Duxbury Press, 1974.

Broad introduction to energy concepts and resources.

B. Periodicals. Articles on energy conservation can be found in the professional and trade periodicals associated with most occupational areas. Following is a list of periodicals that have a major emphasis on energy and environmental issues. Introductory review copies will usually be sent on request.

Catalyst for Environmental Quality. 274 Madison Avenue, New York, N.Y. 10016.

Conservation Foundation Newsletter. 1717 Massachusetts Avenue, N.W., Washington, D.C. 20036.

Conservation News. National Wildlife Federation. 1412 16th Street, N.W., Washington, D.C. 20036.

Ekistics. Athens Center for Ekistics. 24 Strat Syndesmou Street, Athens, 36, Greece.

Energy and Power. National Educational Council on Energy and Power. P.O. Box 618, Concord, MA 01742.

Energy Insider. U.S. Department of Energy. Mail Stop 8G031, Washington, D.C. 20585.

Environment. Scientist's Institute for Public Information. 560 Trinity Avenue, St. Louis, MO 63130

Environment News Digest. 250 Park Avenue, New York, N.Y. 10017.

Environmental Action. Room 731, 1346 Connecticut Avenue, N.W., Washington, D.C. 20036.

Environmental Action Bulletin. 33 East Minor Street, Emmaus, PA 18449.

Environmental Education Report. 1621 Connecticut Avenue, N.W., Washington, D.C. 20009.

Environmental Report. Trends Publishing Company. National Press Building, Washington, D.C. 20004.

Environmental Reporter. Bureau of National Affairs, Inc. 1231 25th Street, N.W., Washington, D.C. 20037.

Environmental Science and Technology. American Chemical Society, 1155 16th Street, N.W., Washington, D.C. 20036.

Journal of Energy. American Institute of Aeronautics and Astronautics. 1290 Avenue of the Americas, New York, N.Y. 10019.

Journal of Energy Education. Energy Information Associates, Inc. P.O. Box 18076, Capital Hill Station, Denver, CO 80218.

Journal of Environmental Education. Heldref Publications. 400 Albermarle Street, N.W., Washington, D.C. 20016.

Journal of Environmental Health. National Environmental Health Association. 1600 Pennsylvania Street, Denver, CO 80203.

Journal of Environmental Management. Academic Press. 111 Fifth Avenue, New York, N.Y. 10003.

Journal of Environmental Quality. 677 South Segoe Road, Madison, WI 53711.

People and Energy. Institute for Ecological Policies. 1413 K Street, N.W., Washington, D.C. 20005.

Resources. Resources for the Future. 1755 Massachusetts Avenue, N.W., Washington, D.C. 20036.

C. Career Related Materials. Following is a list of books and pamphlets dealing with environmental and energy careers. Most of those produced by the government or trade associations are free; those from commercial publishers have a higher cost.

Career Challenges in the Natural Gas Energy Industry. American Gas Association. 1515 Wilson Boulevard, Arlington, VA 22209.

Career Choices: Working Toward a Better Environment. U.S. Environmental Protection Agency. Attn: Personnel Management Division, Washington, D.C. 20460.

Career Opportunities in the Environmental Protection Agency. U.S. Environmental Protection Agency. Attn: Personnel Management Division, Washington, D.C. 20460.

Career Opportunities in the Scrap Metal Industry. Institute of Scrap Iron and Steel. 1729 H Street, N.W., Washington, D.C. 20006

Career Profiles in Forestry, Conservation, Ecology, and Environmental Management. American Forest Institute. 1619 Massachusetts Avenue, N.W., Washington, D.C. 20036

Careers in Environmental Protection by Reed Millard. Published by Messner, a Division of Simon and Schuster, New York.

Careers in Meeting the Energy Crisis. Federal Power Commission. 825 North Capitol Street, N.E., Washington, D.C. 20426.

Conservation Careers. National Wildlife Federation. 1412 16th Street, N.W., Washington, D.C. 20036,

Ecology and Your Career. U.S. Department of Labor, Bureau of Labor Statistics. Occupational Outlook Service, GAO Building, Washington, D.C. 20212.

Environmental Careers by James and Lynn Hahn. Published by Franklin Watts, Inc.

Guide to Conservation Careers. National Association of Conservation Districts. 408 East Main, League City, TX 77573.

Is There a Career in the Electric Industry for You? (A film) Distributed by Counselor Films, Inc.

Is there a Career in Mining, Petroleum, or Gas Production for You? (A film) Distributed by Counselor Films, Inc.

Jobs in the Environment. Published by Science Research Associates, Chicago.

Working Towards a Better Environment: Career Choices. U.S. Government Printing Office, Washington, D.C. 20402

Your Career in Ecology. Ecological Society of America, Department of Biology. Rutgers University, Camden, N.J. 08102

II. FILMS

Following is a list of selected titles of films dealing with energy and environmental topics. All are appropriate for senior high to adult level. The film distributor is also provided. You should, however, check first with your institution's audio-visual department or the closest university film library. It is often easier and less expensive to obtain the films from them than the distributor. The U.S. Department of Energy Technical Information Center also offers on a free loan basis over 200 films. Request the Energy Film Catalog from the Technical Information Center, P.O. Box 62, Oakridge, TN 37830.

A Question of Balance. Edison Electric Institution.
Presents the complexities created by increased energy demands.

A Thousand Suns. Barr Films.
Deals with need for more environmentally-oriented life styles.

Bill Loosely's Heat Pump. National Film Board of Canada.
Demonstrates setting up a heat pump.

Challenge of the Future. Department of Energy.
Deals with energy options for future.

Choices. Counselor Films, Inc.
Choice between balanced growth and environmental responsibility.

Desert Cloud. Airworks.
Explores solar energy.

Energy Crisis. Journal Films.
Explores depletion of fossil fuels and options.

Energy Series. Churchill Films.
A series of excellent films on energy issues.

Geothermal Power. AV-ED Films.
Explains geothermal power.

81

Laws of Conservation of Energy and Matter. Coronet.

Explains First Law of Thermodynamics.

LNG Is On Its Way. Modern Talking Picture Service.

Shows how LNG is brought to U.S.

Natural Gas Fuel Cell. Brooklyn Union Gas.

Traces development of natural gas fuel cell.

Now that the Dinosaurs Are Gone. Atomic Industrial Forum.

Addresses need for nuclear power.

Nuclear Dilemma. Time-Life.

Examines both sides of nuclear issue.

The Other Way. Time-Life.

Presents views of E.F. Schumacher.

Solar Frontier. Mellenco Film.

Explores solar power.

Toast. Earth Chronicle Production.

Explores net energy required to produce a piece of toast.

Understanding Matter and Energy. International Film Bureau.

Outlines forms of matter and energy.

III. USEFUL INFORMATION RESOURCES

The following organizations are good resources for keeping up energy and environmentally related activities. Most of them act as a clearinghouse as they collect, index, and abstract materials produced by the thousands of educational and other research and development institutions involved in energy and environmental activities. Write each to see what services are provided and publications are produced.

Energy and Man's Environment, Inc. 0224 S.W. Hamilton, Portland, OR 97201.

Initiates and supports balanced programs designed to create an energy literate public; compiles bibliographies, resource lists.

Engineering Index, Inc. 345 East 47th Street, New York, N.Y. 10017

Abstracts and indexes materials related mainly to engineering but also reviews Department of Energy and National Technical Information Service materials.

Environmental Information Center, Inc. 292 Madison Avenue, New York, N.Y. 10017.

Clearinghouse for energy and environmental information. Publishes an index and abstract series in both areas.

Environmental Protection Agency, Office of Research and Development, Energy, Mineral, and Industry. 401 M Street, S.W., Washington, D.C. 20460.

As part of its mission to inform the public, the EPA produces and distributes many free materials.

ERIC Clearinghouse on Adult, Career, and Vocational Education. National Center for Research in Vocational Education. 1960 Kenny Road, Columbus, OH 43210.

Collects and prepares abstracts of materials related to adult, career, and vocational education.

ERIC Clearinghouse on Science, Mathematics, and Environmental Education. Ohio State University, 1200 Chambers Road, Columbus, OH 43212.

Collects and prepares abstracts of materials related to science, math, and environmental education.

National Science Teachers Association. 1742 Connecticut Avenue, N.W., Washington, D.C. 20009.

Actively involved in publishing energy related instructional materials and bibliographies.

U.S. Department of Energy, Technical Information Center. P.O. Box 62, Oakridge, TN 37830.

Collects, indexes, abstracts, and distributes energy related materials. Also publishes and distributes free information booklets.

U.S. National Technical Information. 5825 Port Royal Road, Springfield, IL 22161.

Collects, indexes, abstracts, and distributes materials on all technical areas obtained mainly from U.S. government files, including topics related to energy and the environment.

ENERGY CONSERVATION CURRICULUM CONTENT

I. THE FUTURE AND ENERGY

- A. Projected views of the future
- B. Energy conservation in future design
- C. A conservation ethic: Stewardship Worldview

II. NATURE AND ENERGY

- A. Ecosystems and equilibrium
- B. Laws governing energy flows
- C. Analysis of energy flows

III. ENERGY CONSERVING RESOURCE UTILIZATION CONCEPTS

- A. Energy quality and end use
- B. Net energy
- C. Efficiency
- D. Scale

IV. ENERGY AND THE HUMAN SYSTEM

- A. Energy, GNP and economic growth
- B. Energy intensities and jobs
- C. Energy conservation and job opportunities

V. RESOURCE DELIVERY SYSTEMS

- A. Delivery systems
- B. Energy conserving strategies

VI. ENERGY RESOURCES AND NATURAL SYSTEM IMPACTS

- A. Non-renewable resources
- B. Renewable resources
- C. Effects of energy utilization on natural systems

These curriculum content areas were developed by the Environmental Quality and Energy Conservation Curriculum Model Project, Far West Laboratory for Educational Research and Development. The project was funded by a grant from the United States Office of Education's Bureau of Occupational and Adult Education.

ENERGY CONSERVATION CURRICULUM CONTENT

I. *THE FUTURE AND ENERGY*

The future is not fixed; we can be anticipative instead of reactive in designing and bringing about a future with the qualities we desire.

A. *Projected views of the future*

Alternative energy futures are based on different growth projections. Which set of experts do we believe? Which future(s) is most desirable?

B. *Energy conservation in future design*

Common to the realization of a desirable energy future is the strategy of energy conservation. What are some of the different meanings of energy conservation?

C. *A conservation ethic: Stewardship Worldview*

Energy conservation, conceptualized in the broadest manner embodies an ethic which can be explored through what is termed a Stewardship Worldview. Such a worldview provides a philosophical perspective which can assist in our thinking and making decisions about future energy policies.

II. *NATURE AND ENERGY*

The natural system is the ultimate origin for all resources. There are certain fundamental laws and principles governing the flow of these resources and functioning of the natural system. These laws and principles ultimately influence what human technologies can and cannot do.

A. *Ecosystems and equilibrium*

Ecosystems function through two important processes of chemical cycling and energy flow. Ecosystems are continually changing, evolving and attempting to maintain a balance referred to as a dynamic equilibrium. This is an important concept because humans have the ability to create imbalances (through pollution, land form changes, etc.) whose consequences we cannot always predict or control.

B. *Laws governing energy flows*

Energy flows in human and natural systems are governed by two fundamental laws. These are the Law of Energy Conservation and the Law of Energy Degradation.

C. *Analysis of energy flows*

In order to visualize the interactions and impact points of human activities upon natural system functioning, it is useful to diagram the energy flows governed by the two laws described above.

III. *ENERGY CONSERVING RESOURCE UTILIZATION CONCEPTS*

To process and utilize energy requires the application of different kinds of technologies. In assessing the appropriateness and energy conserving potential of our current and project energy technologies, it is helpful to use several relevant concepts.

A. *Energy quality and end use*

A great deal of energy is required to produce high quality energy; quality being a measure of a substance's potential to do work. Since high quality forms of energy are expensive it should be used to meet only high quality end use requirements. Energy can be conserved if we match energy quality and end use needs.

B. *Net Energy*

The concept of net energy relates to the true value of an energy source after all energy costs have been subtracted. In terms of energy conservation, the concept of net energy enables us to assess the true value of any energy resource.

C. *Efficiency*

When applied to energy use, efficiency may be measured differently depending on whether calculations are based on the first or second law efficiency definitions.

D. *Scale*

The concept of scale also should be used to assess current and proposed energy technologies. Like energy quality, complexity of scale should be appropriate for end use so that end use needs are the prime consideration rather than the needs of the energy source controlling the end use.

IV. *ENERGY AND THE HUMAN SYSTEM*

Energy is used to satisfy human system needs. We must examine energy policies which propose to satisfy these needs in different ways to insure that future policies are supported which emphasize, among other things, kindly use of resources, increased opportunities to satisfy human needs (i.e. meaningful and gainful employment) and a high quality of life. Concerns such as these require that we look carefully at certain aspects in proposed energy policies.

A. *Energy, GNP and economic growth*

Recent economic analysis has begun to show that the relationship between GNP and energy growth is not as wedded as usually portrayed. What is the relevance of this with respect to projections of the future?

B. *Energy intensities and jobs*

The energy content of goods and services is often referred to as their energy intensity. In assessing proposed energy conserving policies, it is critical to look at the relationship between energy and labor intensity and the capital investment per job of different industries.

C. *Energy conservation and job opportunities*

Besides considering the quantity of jobs that may be created by energy conserving policies, it is important to look at the quality of potential employment opportunities and the areas in which they are being developed. There is some evidence that energy conserving approaches may result in increased opportunities for more meaningful jobs.

V. *RESOURCE DELIVERY SYSTEMS*

To identify all the areas which have the greatest potential for conserving energy, it is necessary to examine the total system of resource production and utilization from its exploration through to its end use. One way to examine the total system is through a framework which lists the major stages or steps involved in a particular system. Once these stages are outlined, the net energy savings of various conserving strategies can be assessed comprehensively.

A. *Delivery systems*

A delivery system consists of the steps or stages required to change a raw resource into useful work. Within each of the eight steps listed below, it is possible to calculate total energy costs: (1) exploration; (2) extraction; (3) transport I; (4) processing; (5) transport II; (6) conversion; (7) distribution; and (8) end use. Totaling these costs would thus enable us to look at the energy intensive nature and hidden energy costs of the goods and services we use.

B. *Energy conserving strategies*

A comprehensive analysis of the net energy savings of proposed energy conserving strategies can be assessed through using concepts such as the delivery system framework outlined above and net energy, energy quality and end use described earlier.

VI. *ENERGY RESOURCES AND NATURAL SYSTEM IMPACTS*

The primary energy resources available for use are of two basic types; renewable and nonrenewable. There are many factors which enter into the decision making process with respect to the supply of these resources and the impact of their extraction upon the natural system.

A. *Non-renewable resources*

The following resources are considered non-renewable because their rate of renewal, relative to the demand for these resources is so slow that the available supply could be depleted: fossil fuels (coal, tar sands, petroleum, natural gas, oil shale, lignite) and nucleur (fissionable and fusionable materials).

B. *Renewable resources*

Resources such as the following are considered renewable in that they exist in continuous supply even though it must be noted that the supply is potentially exhaustible: solar, fresh water, oceanographic tides, temperature gradients, geothermal steam and heat, wind, biomass and life forms.

C. *Effects of energy utilization on natural systems*

Impacts on the natural system of energy utilization practices and technologies are generally classified into two major categories: pollution and degradation.

APPENDIX F:

Project Information Sent To State Directors
of Vocational and Adult Education

THE ENERGY CONSERVATION CURRICULUM MODEL: AN ORIENTATION

A Perspective on Energy Education and Energy Conservation

The "energy crisis" sparked by the 1973 oil embargo may be seen as the "sputnik" of the '70's. Both events, for a different set of reasons, have greatly influenced large sectors of the American public. Nearly every facet of our lives, in fact, has been influenced in some way by the energy crisis and ensuing policy decisions made in response to it. As indicated in a recent national assessment of energy awareness among young adults,

> Americans have been forced to consider energy issues because of increasing costs and the sudden recognition that certain vital resources in our country are being severely depleted. Energy problems have obvious implications for government, for business and commerce and for foreign policy--but they impinge on individuals and their current life-styles as well.[1]

And, the solutions for these energy problems are seen to depend heavily on the knowledge and attitudes of an informed citizenry.[2] Since the energy crisis, leaders in both the formal and non-formal education sectors have attempted to articulate their role and responsibility relative to creating an informed public. The major response has been the development of curriculum and instructional materials in what is generally called "energy education." Although the objectives and activities of the various energy education programs vary, as Donald Duggan of the Department of Energy's Educational Division has said, "the scope of energy education is to educate our future citizens to make the very difficult decisions that they will make as citizens, voters, and consumers."[3]

Within the context of energy education, energy conservation should be an important and fundamental topic. It is sometimes thought that energy conservation education involves training people to save energy through various changes in behavior like insulating homes, lowering the thermostat, etc.

These outcomes, while important, are energy conservation only in its very narrowest sense. In a much broader sense, energy conservation requires that we understand how much energy we are using and also how wisely and appropriately we are using it. The criterion for appropriateness involves considerations of environmental quality and the quality of human lives. In this broader context, it is difficult to distinguish between energy education and energy conservation education. Both involve discussions of many of the same topics and both are oriented toward enabling persons to make individual and collective decisions that will help remedy energy problems.

Energy Conservation in the Context of Vocational Education

Within the field of vocational education considerable attention has been placed of late on energy topics, particularly the role of vocational education in solving the energy dilemma. A review of the literature written by vocational educators reveals two areas of responsibility, and a third is less clearly articulated.

The first and most obvious responsiblity of vocational education is to train workers in fields related to current and future energy technologies. In a special 1977 report to the President of the United States on the role of vocational education in the energy crisis, the National Advisory Council on Vocational Education outlined this responsibility in the following manner.

> Now is the time for vocational education to begin to prepare for the emerging technologies and industries of the 1980's. The preparation which is demanded from the vocational education leadership lies primarily in the area of curriculum development....In addition, all vocational education counselors and instructors in the energy technology and industry occupations must begin to acquire at least a minimum background of alternative energy sources and energy delivery systems. All must be prepared also to respond in a positive way to the necessity for diminishing the demand for energy.[4]

Moving from this global statement to a more specific definition of vocational education's role, one finds recommendations such as:

> In the middle grades, industrial arts programs can provide the awareness and orientation to the energy problem and alternative sources. In the senior high school, vocational trade programs can prepare installers and assemblers. At the post secondary level, technicians can be trained. In all schools energy education must take its place as a curriculum imperative.[5]

A series of recent articles in VocEd, the journal of the American Vocational Association, outlined a second role for vocational education.[6] The authors of many of these articles suggested that energy concepts, techniques, and skills should be incorporated or integrated into existing occupational programs that have potential for addressing the energy situation in some relevant way. Fields such as agriculture, automotive mechanics, home economics, and the building trades are suggested as fruitful areas for the inclusion of new energy knowledge. For example, concepts and techniques related to insulation, weatherproofing, and efficient building techniques can be integrated into construction trade curricula. One possible result of this may be the energy conservation technician: a person who is competent in the established skills required for existing occupational areas, but who is also competent in assessing and developing techniques to better use energy.

Finally, there is a third area in which vocational education can assume a responsibility in dealing with our energy problems. This role has not been expressed clearly by vocational educators themselves but can be inferred from what has been suggested as necessary for solving the energy dilemma. The suggestion is that all workers, whether or not they are directly involved in energy technologies or energy-related fields, need to possess an energy ethic. They should be able to understand the importance of energy use and its relationship to their respective occupations, as well as to their personal lives.

As Ione Phillips, editor of VocEd has said, "...no field of vocational education can afford to stand back and say, 'the nation's energy problem is of no concern to us.'"[7]

This is a more subtle but more fundamental responsibility of vocational education. It implies that our nation's energy problems will not be solved by energy technicians or specialists alone. We will need citizen-workers who possess not only the usual competencies to be successful in their respective fields but also an expanded awareness which includes an energy ethic. Knowledge about energy conservation in its broadest sense can contribute to the development of this energy ethic.

Current Energy-Related Activities of Vocational Education

Given that these three areas represent major responsibilities of vocational education in dealing with our energy problems, what has happened in the vocational and technical education arena relative to the development of energy-focused programs and curricula? What, for example, have been the major curriculum development efforts? There have been a number of surveys and studies that have attempted to assess the status of energy education at the post-secondary vocational as well as adult education level.

In an informal survey conducted at Far West Laboratory in 1977, at the beginning of this project to develop an energy conservation curriculum model, we attempted to compile documents which reflected vocational and adult education plans with respect to energy education in each state. From the materials returned, it was obvious that the majority of states recognize the need for and importance of energy education, but there were few comprehensive plans at the state level for implementing an energy-related curricula. State vocational and post-secondary adult educators, for the most part, did not have state plans or blueprints for what should be done, but could point to

individual efforts that were functioning well or in the planning stages. These efforts were primarily to train technicians in energy-related areas like weatherization, water treatment, solar and coal technology. Few of these plans specified what competencies the technicians should possess.

A more recent and comprehensive survey assessing current offerings throughout the country of energy-related training activities was conducted for the Department of Health, Education and Welfare. Data were compiled relative to the following twelve energy-related areas: audits, awareness, conservation, management, nuclear, petroleum, solar, coal, geothermal, ecology, wind, and biomass.[8] The survey thus provides a profile of energy-related courses, training programs, seminars, degrees, etc., offered by government agencies, private consultants, businesses, and at public and private two-year post-secondary educational institutions. From these data, compiled according to states, it is evident that most institutions have concentrated their efforts in the development of courses and training programs in the area of solar energy. Secondary areas of effort were in the fields of coal and petroleum technologies. The offerings in the areas of geothermal, wind, and biomass appear neglected, and the absence of activity in the nuclear area seems related more to the source of the survey data (two-year post-secondary institutions) rather than to the number of existent programs.

Noticeably absent from this assessment are offerings from institutions in both energy awareness or conservation and energy-related technologies. When the topics of energy awareness or conservation are covered, they usually appear as part of the general community college curriculum rather than in vocational technical programs. Thus, it is possible that the technical programs can be training technically competent workers in areas that are important for solving our energy problem, but who are not necessarily citizen-workers with an understanding of appropriate energy-use concepts. It is

conceivable, for example, that we might be training solar energy technicians who carry out their job in an energy inefficient fashion or who cannot apply their energy understanding to their own personal lives.

Another study contributes a different perspective to this present inquiry into how educators, vocational and technical in particular, have responded to the "energy crisis."[9] The study examined post-secondary energy and power programs throughout the United States, looking at course topics or content, textbooks, and classroom materials presently offered by educational manufacturers and distributors. Table 1 presents the results of this study.

Table 1

INFORMATION SOURCE

CONTENT AREA	Colleges	Textbooks	Educational Materials
INTRODUCTION			
Conservation	10	14	0
Energy Policy	6	14	0
History and Future	10	20	0
SOLAR			
Thermal	10	11	2
Photovoltaic	5	10	2
Wind	11	10	2
ELECTRICAL			
Transmission	8	11	4
Generation	12	12	4
FUELS			
Fossil	11	19	3
Nuclear	10	20	1
Wood	2	4	2
Methane	7	10	2
Hydrogen	8	12	2
Geothermal	7	11	2
WATER SOURCES			
Hydroelectric	11	11	1
Tidal	4	8	1
Sea Thermal	4	9	0
CONVERTERS			
Steam	10	9	2
Internal Combustion	12	4	4
Fluid	12	3	4
Air	6	3	2

From "Post-Secondary Energy and Power Curriculum Study" by Stanley Primak and Rodney Anderson, Energy and Power Journal, 2, 1978, 10-16.

Two interesting results emerge from this study. First, the topic of conservation appears under the "Introduction" heading and does not appear to be integrated in any other manner into the remaining subject headings. This gives the appearance at least that one can examine, for instance, the topic of electrical energy separate from discussions about conservation. In reality we do not know how these topics are presented in relation to a particular set of program objectives; the results suggest, however, that conservation may be an optional topic in many energy-related curricula. The second interesting result is the complete lack of educational materials from commercial publishers dealing with the conservation content area.

One final study is of interest. Although the purpose of the study was to survey precollege energy education curricula, the results are worth noting. This survey, conducted by the Energy Institute of the University of Houston, reached the following conclusions:[10]

(1) Energy education materials tend to stress technical topics.

(2) They do not adequately stress policy issues and the political and economic milieu in which controversial policy issues are resolved.

(3) They often lack consistent core themes and adequate conceptual frameworks.

(4) They provide little that is useful in the development of an alternative energy ethic.

Based on these studies, then, we can make some tentative generalizations about the responses of educators, post-secondary and vocational in particular, to the energy "crisis" situation.

(1) There are few comprehensive plans at the state level to guide the systematic development and implementation of energy-related curriculum offerings into post-secondary adult and vocational programs. Existing programs seem to be the result of individual and somewhat isolated efforts rather than in response to imperatives or recommendations from the educational or governmental sectors.

(2) An increasing number of post-secondary institutions are becoming involved in providing solar training programs as solar energy becomes "big business." Plans are being made to develop training programs in other energy (conventional as well as alternative) technical fields. There is an uncertainty, however, concerning the demand for jobs in these fields and the competencies which will be required.

(3) The emerging programs tend to stress technical topics and do not necessarily address or incorporate aspects of energy awareness or the acknowledged necessity for the development of an energy aware literate citizenry.

Given these results, it would seem that post-secondary vocational education as a whole is making a strong effort to meet the need for competent workers in both conventional and alternative energy fields. It is less clear whether efforts are being made to incorporate technical skills training related to efficient energy use in fields such as agriculture and the building trades. It is even less clear that these programs are addressing the need for all to be energy literate citizen-workers.

Governmental agencies, as well as various educational institutions, have recognized this need for more and better energy programs and materials and have attempted to address this need through teacher training. Within the last few years, many institutions have sponsored workshops for educational personnel. For example, the Department of Energy, working mainly with educational institutions, sponsored 68 faculty development workshops during the summer of 1978, with emphasis placed upon increasing understanding of energy issues and options. Most of these were specially targeted for post-secondary vocational personnel. In addition, numerous regional and national conferences are being held on energy-related topics.

What seems to be missing in efforts such as these is an intent to provide educational personnel with not only information and data <u>about</u> energy, but also a conceptual framework or structure <u>within</u> which to put such information. There appear to be few attempts to develop a framework based on a conception

of what constitutes a comprehensive understanding of energy, particularly as it leads to the wise and effective use of energy resources or energy conservation. This lack of a conceptual framework has an important consequence for educators desiring to provide course offerings that go beyond basic energy "facts," and which lead to the adoption of an energy ethic or awareness. To expand into such areas requires, first of all, that educators themselves understand the conceptual structure of the subject matter per se. This means that educators must understand the essential concepts and principles of energy and have a framework for relating this knowledge to the wise and effective use of energy resources. Without such a prior conceptual understanding, it is difficult to select materials and learning resources which insure that students will be exposed to instructional situations that lead not only to a technical understanding of energy or the development of an energy-related technical skill, but also, more importantly, to the development of a basic energy literacy.

Purpose of the Energy Conservation Curriculum Model

The purpose of the Energy Conservation Curriculum Model described in the remainder of this document was to respond to this need for a systemic, conceptual framework for understanding energy, particularly focused on those elements that lead to a broad-based understanding of energy conservation. The development of these Model documents was the outcome of a project sponsored by a grant from the United States Bureau of Occupational and Adult Education. The specific goal of the project was to design a curriculum model for use by post-secondary adult and vocational educators in the area of energy conservation and environmental quality. In designing the Model an emphasis was placed on developing a conceptual framework and specifying content areas which should enable educators to understand these issues in a systemic manner. Based on

this understanding of the essential or key aspects, educators can design and develop curricula and instructional materials tailor-made for the needs and interests of their students.

The project focused on energy conservation for several reasons. First of all, in this decade energy has been and continues to be an important and challenging issue. Second, as has been pointed out, "the extraction, conversion, and application of energy have been dominant ingredients of industrial society's assaults on the environment; to understand the environmental impact of energy is to grasp much of the environmental predicament as a whole."[11] Thus, the Curriculum Model itself has been imbedded within a context of energy's impact on the environment as well as in the context of human needs.

In addition to the ideas about what constitutes the appropriate roles of vocational and adult educators in dealing with our energy problem, the Curriculum Model documents were based on the following assumptions:

- There are many informative materials, films, pamphlets, etc., available to educators on energy-related topics. Often these are free or available at low cost from organizations like governmental agencies, utilities and citizens groups.
- There are few teacher training materials to assist educators in understanding the essential and generic concepts and principles necessary for exploring energy issues in a systematic manner.
- Whenever possible, these concepts and principles should be integrated or infused into existing curricula rather than taught as a separate course.

- Educators need to have such a conceptual understanding of energy conservation in order to design and adapt their own curricula or instructional materials and to assess and use available materials most effectively.
- The best groups to develop or adapt materials are the teachers or instructors themselves.[12] What is important is to insure that they have a sound conceptual base from which to start.

The Curriculum Model Documents

The Energy Conservation Curriculum Model is described in a series of four documents. These documents are addressed mainly to instructors, but are also for use by administrators who have curriculum or instructional development responsibilities.

The first document in the series is the Orientation Guide. The Guide is designed to provide a context for energy conservation within vocational education, to elaborate on the assumptions that influenced the design of the Model, and to provide an overview of the remaining documents and their uses. The remaining documents are the Curriculum Content Model, the Resource Book, and the Application Guide.

The Curriculum Content Model presents an essential set of concepts and principles important for gaining a comprehensive understanding of issues related to energy conservation. These are presented in the form of a visual map, which identifies and locates these essential elements. Environmental quality topics are an important part of this map, as are issues that relate to the quality of human life. Because the model is intended for use by vocational educators, these human quality aspects specifically focus on current and future job opportunities.

The purpose of the Curriculum Content Model is to provide a conceptual orientation and approach for users as they explore additional resources (such as those identified in the Resource Book), assess currently available energy-related materials, or develop their own materials. The Curriculum Content Model, in serving as a conceptual map and orientation, is not designed necessarily as a curriculum outline to be taught to students. Rather it is intended to be internalized by the instructors and to act as an organizer that will enable instructors to explore energy issues and materials in a systemic fashion.

The Resource Book contains two parts. The first part presents an elaboration of the key knowledge elements specified in the Curriculum Content Model. A section is devoted to each of the six sectors in the Content Model. Included in each section are references for further study related to the particular topics discussed. This manner of presentation supports the ultimate purpose of the Resource Book and Curriculum Model, which is to provide a comprehensive context for the use of readily available materials rather than serve as an exhaustive examination of particular topics.

Part two of the Resource Book provides a more complete bibliography of energy-related materials. Included in this bibliography are listings of films, career information materials, and periodicals. In developing this list, emphasis was placed on including information resources that would have a multiplier effect and lead the user to even more relevant materials.

The Application Guide is designed to illustrate how the preceding elements in the Model can be used in the instructional process. A general strategy for integrating energy conservation into the existing curriculum is presented. The remainder of the document provides several sample curricula and sets of suggested activities. It is important to note, however, that these outlines

and activities are provided as application illustrations to provide an impetus for additional thinking and are not intended to be prescriptive.

These four documents constitute the Curriculum Model as a whole. It should be noted that the Model is written in general terms. Its generic value provides an initial conceptual base for the development of programs and materials in specialized vocational and adult education fields. These specialized programs and materials should be directed at instructors, administrators, and curriculum designers providing them with a comprehensive understanding of energy conservation. In this way, they will be able to develop new curricula or to change their current programs in a systemic manner, tailor-made to the needs of their students.

FOOTNOTES

1. National Assessment of Educational Progress, Energy Knowledge and Attitudes (Denver: National Assessment of Educational Progress, 1978), p. xi.

2. The proposed solutions to the 1979 version of the U.S. energy crisis are an example of this dependence on informed citizen support.

3. Donald Duggan, as quoted in Lillian A. Clinard, "Conservation--We Have Met The Enemy," VocEd, 54,1 (January, 1979), pp. 35-37.

4. National Advisory Council on Vocational Education, The Response of Vocational Education to the Energy Crisis (Washington, D.C.: National Advisory Council on Vocational Education, December, 1977).

5. Ralph V. Steeb, "Editorial," Energy and Power Journal, 2,5 (September, 1978), p. 2 (emphasis added).

6. See entire issue of VocEd, 54,1 (January, 1979).

7. Ione Phillips, "Editorial," VocEd, 54,1 (January, 1979), p. 27.

8. Daniel M. Hull, Curriculum for Energy Use- and- Conservation Technicians (Waco, TX: Technical Education Research Centers, Southwest Centers, 1979). Report No. 78-63-02B prepared for the U.S. Department of Health, Education, and Welfare.

9. Stanley Primak and Rodney Anderson, "Post-Secondary Energy and Power Curriculum Study," Energy and Power Journal, 2,5 (September, 1978), pp. 10-16.

10. Robert M. Jones and John E. Steinbrink, A Survey of Precollege Energy Education Curricula at the State Level (Houston, TX: Energy Institute, University of Houston, June, 1977), p. 8.

11. Paul R. Ehrlich, Anne H. Ehrlich, and John P. Holdren, Ecoscience: Population, Resources, Environment (San Francisco: W.H. Freeman, 1977), p. 389.

12. John M. Fowler and King Kryger, "Emergency Vocational Instruction," VocEd, 54,1 (January, 1979), pp. 41-43.